

VETCH

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How It Builds Up Sandy Soil
How Its Humus Feeds Orchards
How It Helps All Other Crops
How It Must Be Inoculated
How It Saves Fertilizer Bills
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VETCH

"The King of Soil Builders"

By W. H. Matchette

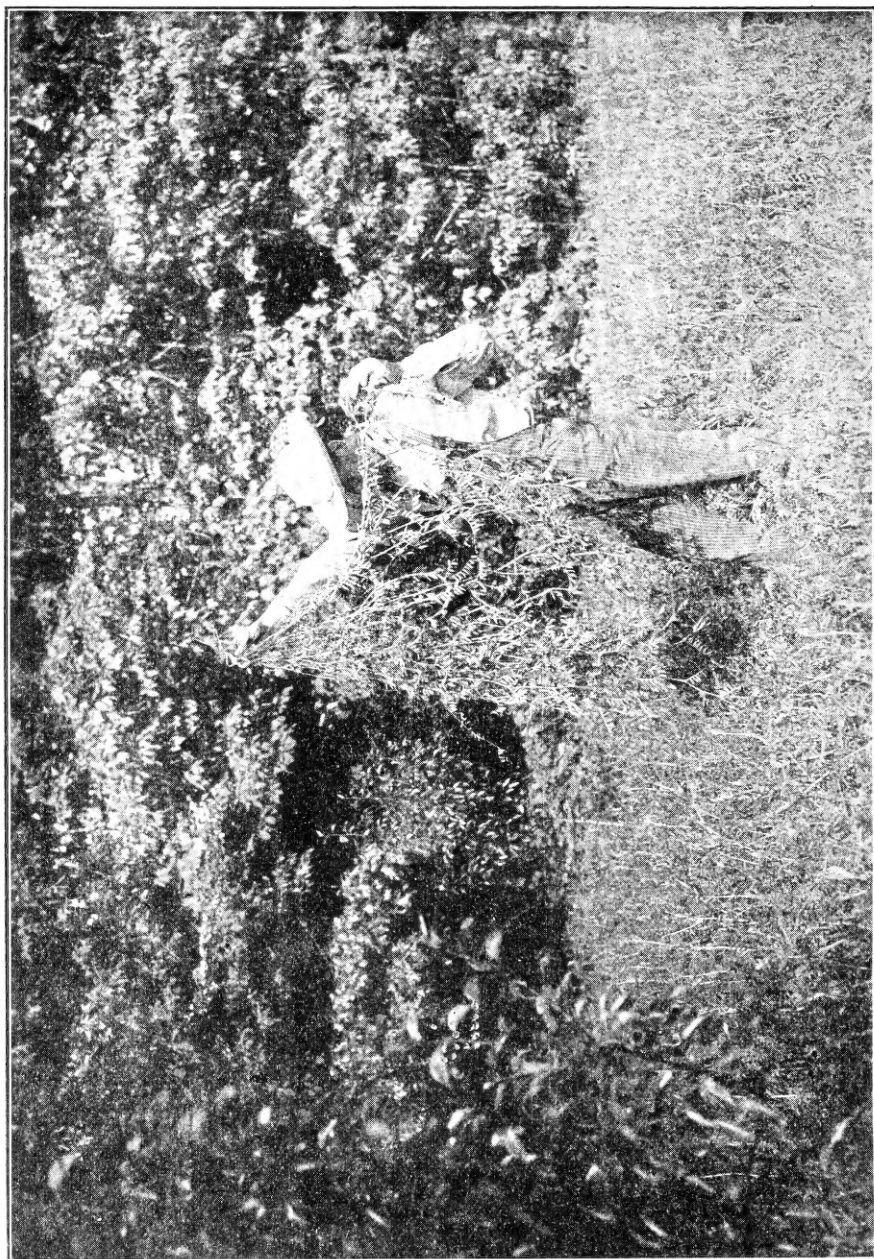
Price 25 cents

Published by

The Galloway Bros.-Bowman Co.
Waterloo, Iowa

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SB 205
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A Single Hairy Vetch Plant.
(From Circular No. 13, Mich. Agr. College.)



VETCH

The King of Soil Builders

DID you ever read the "Arabian Nights"?
Did you ever read the story of "Aladdin's Lamp"?
Now these stories, of course, are fables and sound like great exaggerations, but—

I want you to read this book on Vetch, because when you sit down, take a pencil and figure out what this King of Soil Builders, Vetch, will do for land that you want to build up, for any old, cropped out, depleted soil, or for any unprofitable, sandy soil, it will almost make you say that it sounds like a story in the "Arabian Nights".

If you have any thin, cold, dry, hungry soil, which you want turned into warm, moist, fertile soil, rich in humus and nitrogen, you should carefully read and study this book twice.

It will tell you about Vetch, the wonderful Green Manure Crop. How it makes a greater growth of vegetable matter, than almost any other crop, and at the same time steals more free nitrogen from the air than any other farm legume. This book also tells how Vetch increases the yield of corn, potatoes, cotton, tobacco and the grain crops.

Imagine for example, a corn crop that takes out \$35 worth of nitrogen an acre. This can be replaced by simply sowing vetch between the rows at the last cultivation, which will give you a green forage crop for fall and spring, that will draw the \$35 worth of nitrogen back to the soil from the air, which the corn consumed in its growth, and then by turning the green crop under, it gives you humus the equal of which cannot be put into the soil either in quality or quantity by barnyard manure or commercial fertilizer.

If you want cattle food of the highest excellence—

If you want a profitable soiling feed which may be cut and fed green to stock at most any stage of its growth—

Put in Vetch.

If you want a palatable, digestible hay, one that makes a good substitute for red clover and is ready to harvest by the middle of June—

Put in Vetch.

If you want an early spring pasture that makes a crop when green forage is scarce (before spring and summer grasses come in)—

Put in Vetch between the rows of corn at the last cultivation.

To me this is one of the most wonderful crops the farmer can grow.

It clearly demonstrates what nature will do for you if you let her, and give her an opportunity.

No farmer's land would remain sick and worn out if he but studied the different legume crops, used his head, and let Nature do the work.

That's why I want you to especially study this book on Vetch—the King of Soil Builders.

Many farmers have sandy land and have been at a loss to know how to make it valuable and productive. Vetch is the answer.

Nearly all farmers have a piece of ground, a field, or a part of their farm which has been cropped so long and so often that it will scarcely grow a crop, even a decent crop of weeds. How to bring such worthless soil back to its original fertility is a vital question never answered more fully in detail than it is in this new book on Vetch.

For a long time sandy land in some localities has been considered without value, and not only a drug on the market but an expense to the owner, and in many cases not even worth the taxes. Grow inoculated Vetch on this kind of land.

You will be surprised at the results.

Vetch will pay in the Corn Belt.

Many farmers think because their land is black as their hat, because it is in the Corn Belt, or even because it is in the fertile plains of Manitoba, Saskatchewan and the great Canadian Northwest, that they don't need a crop like Vetch, when as a matter of fact they are fooling themselves and would find that Vetch even in the very deepest black soil would prove a money maker for them.

It is a dividend payer, and a crop that every farmer should grow on his farm.

For that reason I would like to have you study over this book very carefully because it is an eye opener to many and you will then know why we call this book "Vetch, the King of Soil Builders."



President.

GALLOWAY BROTHERS-BOWMAN CO.,
Waterloo, Iowa.

CHAPTER I.

Hairy Vetch A Great Forage Crop

DESCRIPTION — DISTRIBUTION — SOIL REQUIREMENTS — PREPARING THE SOIL — SOWING — GROWING — SEED FOR HOME USE — FEEDING VALUE — ITS CHIEF USES AS FEED — SPRING PASTURE — ENSILAGE — FOR SOILING — FOR HAY — FOR MILK COWS — FOR HORSES — CHIEF CAUSE OF FAILURE.

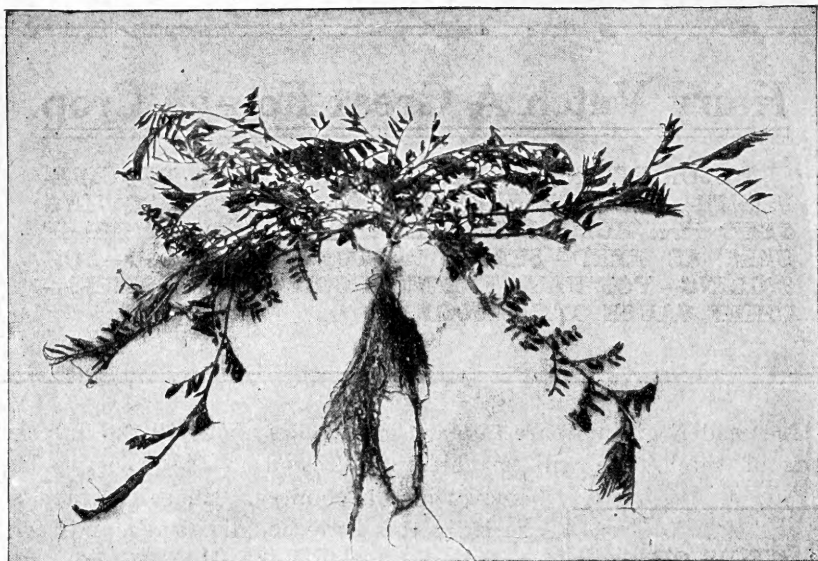
KINDS OF VETCH

The reader will not care to learn particulars about all the different kinds of vetch. He will be chiefly interested in the varieties best known in this country. Hence the facts set forth in this little booklet deal mainly with hairy and common vetch, with but little space—far less than they deserve—devoted to the other varieties, such as black bitter vetch, scarlet vetch, purple vetch, and woolly-podded vetch. There are about 120 kinds of vetch. In the United States, where some twenty wild kinds are found, they are commonly known as wild peas. Many of these different vetches are comparatively unknown to the American farmer, while others are growing in favor and covering greater areas every year. But, as I have said, the varieties of vetch best known to American farmers are common vetch, or tares, and hairy vetch. As the latter is of much greater importance, particularly as a soil-builder, I will discuss it first.

HAIRY VETCH is also known as sand vetch, Russian vetch, Siberian vetch, and villous vetch. Its seeds are small and somewhat resemble sweet pea seeds. The growing plant, until it blossoms, looks like the sweet pea; when in full bloom the field is a sea of beautiful, bluish-purple clustered flowers. The plant is a branching, climbing vine, a great many of its branches reaching the length of

DESCRIPTION OF HAIRY VETCH

seven to ten feet. A full grown crop forms a dense mat, completely covering the ground to the depth of one to two feet. When grown in combination with some strong growing plant, say wheat, rye, or oats, it is supported and kept entirely above the ground. The main stem of the hairy vetch is soft and spongy and slightly ridged, the entire plant being covered with very fine hairs.



A Hairy Vetch Plant.

(From Bul. No. 149, Conn. Agr. Experiment Station.)

DISTRIBUTION

Hairy vetch is, very hardy and is therefore adapted to a wide range of distribution. It has been successfully grown in nearly all parts of the United States; it succeeds well wherever the Common vetch will grow, and it will withstand the winters of eastern Washington, Michigan, New York, and even of New England. It succeeds especially well on sandy soils, but it can be grown on any well-drained land. It is a common thing to see it grow and thrive and make a good crop under dry conditions that would kill off the common vetch.

The question of what soils are most suitable for vetch is not particularly important, for it is a very democratic plant; it will grow and thrive on most any soil.

SOIL REQUIREMENTS

It will grow on rich fertile fields and it will make its home on poor, thin, sandy soils.

While it is grateful for what moisture is given it the first few weeks of its growth, when it is once established its ability to resist drought is astonishing. Another thing in its favor is the fact that it is quite resistant to alkali and will germinate well in soils too alkaline for most legumes.

Although hairy vetch is no respecter of soils and will grow almost

anywhere without any special preparation of the soil, provided the seed is well inoculated, it is always a wise practice to give it as firm a seed bed as possible.

PREPARING THE SOIL

It is an easy matter to do this on light soils, but such soils should also be firmed by running the roller over them before sowing the seed.

Sown in early spring, when the ground is moist and the conditions generally favorable for growth, hairy vetch will develop rapidly. It

SOWING HAIRY VETCH

will be in full blossom by the middle of August and will continue to grow and remain green until the ground freezes in the winter. A few seeds will be found in the late fall, but spring sowing is not advisable if one wishes to harvest a crop of seed.

Sown in the fall, that is, any time between the first of August and the first of October, it will germinate after the first good rain and grow very rapidly before winter sets in. By the time the coldest weather appears the plants are well rooted and able to withstand the freezes. In the following spring it will continue its marvelous growth, developing blossoms by the first of June and ripening its seeds by the middle of July.

When sown in the fall, September is considered the ideal month. If sown alone, about 40 pounds of good seed to the acre are sufficient, though as high as 50 pounds are frequently used. As a general practice it is best to sow it in conjunction with a small-grain crop, such as oats, winter wheat, or rye. Oats are usually used in the South, but in the North wheat or rye must be used. Rye is generally the choice, but if intended for hay the wheat combination is more nutritious. When growing such mixtures for seed, enough grain is used to make about two-thirds of a stand and twenty pounds of the vetch seed are added. Such a mixed crop is easily cut with a mower having a swather attachment, or even with a binder. If more vetch is used it is liable to lodge, especially in spots where the vetch is thick, and the mowing is therefore rendered more difficult.

If its seed could be obtained anywhere near as cheaply and abundantly as most other seeds, hairy vetch would quickly take a very important place in American agriculture. In spite of the high price of seed, the crop is constantly growing in favor and its area rapidly extending. More and more the southern farmer is growing vetch for winter cover and hay, while the northern farmer

GROWING SEED FOR HOME USE

is becoming alive to its superior qualities as a soil builder, especially on sandy lands and on soils where red clover no longer thrives.

This increase in the American demand for vetch is the principal reason for the high price of its seed; the actual supply in Europe is not large, and thus far very little vetch seed has been produced in this country.

I often wonder why the American farmer does not grow his own vetch seed. He can economically grow it for home use in most any State in the Union, and if he has any surplus can always sell it at good prices.

No, there is not the least doubt but that a good crop of seed may be grown in most any part of the country. The largest crops have been grown on the Pacific Coast. The northern States also produce big crops, while in the South the seed crop seems to vary with the season, but often yielding good returns.

Hairy vetch is a winter annual, behaving much like winter wheat. If planted in the spring it may produce a few blossoms the same season, but will make little or no seed until the following season. If planted in the fall it ripens its seed crop the following July. Hence it follows that spring sowing for a seed crop is seldom advisable except on the Pacific Coast and in the arid regions. When vetch is spring-sown for seed it is best to pasture the crop the first season.

The most successful seed growers plant in the fall, using from 30 to 45 pounds of seed to the acre, together with about one peck of rye. The rye holds up the vetch, so that it can be easily harvested. When seed is ripe it is cut and threshed with the ordinary threshing machine, the seed separated with fanning mill.

Hairy vetch ripens its pods over a period of two or three weeks. The best crops are obtained when the first pods are fully ripe and the upper pods well filled. The upper pods will ripen in the shocks, and if carefully handled comparatively few of the ripe pods will shatter. It is always best to cut the crop early in the morning or on a cloudy day. At all events, the vetch, whether cut in bundles or otherwise, should be put into shocks at once and left till threshed. As already stated, the important thing is to handle the cut crop quickly and just as little as possible.

Under favorable conditions 10 to 12 bushels of hairy vetch seed to the acre can be grown. Even at \$3 or \$4 a bushel, such crops are very profitable, and at this price the demand for the seed would increase enormously. A home-grown supply of this seed is badly needed and it is to be sincerely hoped that American farmers will take advantage of this fact, and that such source of seed will soon be available.

Feeding Value Of Hairy Vetch

One can more readily appreciate the increasing importance of vetch as a farm crop if he realizes, not alone its fertilizing value to the soil, but also its value as a feed for animals.

It is generally conceded that hairy vetch is our richest legume. It makes hay of fine, digestible quality, it provides excellent pasturage, and it is used very profitably as a soiling crop. Since these qualities depend largely upon the amount of digestible nutrients in the plant, I give below a table showing that in this respect hairy vetch ranks very high—in most instances pre-eminently so—when compared with other forage crops. This table is taken from Henry's Feeds and Feeding, pages 585-6. It also gives the fertilizing constituents of the respective plants, and in this connection you will note that none of these plants ranks as high in its protein (nitrogen) content as hairy vetch.

TABLE 1—DIGESTIBLE NUTRIENTS AND FERTILIZING CONSTITUENTS.

Name of Feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 lbs.			Fertilizing Constituents in 100 lbs.		
		Crude protein Lbs.	Carbohy- drates Lbs.	Fat Lbs.	Nitro- gen Lbs.	Phos- phoric Acid Lbs.	Potash Lbs.
Dried Roughage.							
Cured hay from the grasses, etc.							
English hay	86.0	4.5	44.0	1.2	12.6	3.2	16.1
Timothy, cut in full bloom	85.0	3.4	43.3	1.4	9.6	5.0	14.1
Timothy, cut soon after bloom	85.8	2.5	39.2	1.5	9.1
Timothy, cut nearly ripe	85.9	2.1	40.1	1.1	8.0
Orchard grass	90.1	4.9	42.4	1.4	12.9	3.7	16.9
Red top	91.1	4.8	46.9	1.0	12.6	3.6	10.2
Kentucky blue grass..	86.0	4.4	40.2	0.7	12.5	4.0	15.7
Hungarian grass	86.0	5.0	46.9	1.1	12.1	4.3	15.4
Cured hay from legumes:							
Red clover	84.7	7.1	37.8	1.8	19.7	5.5	18.7
Mammoth red clover..	78.8	6.2	34.7	2.1	17.1	5.2	11.6
Alsike clover	90.3	8.4	39.7	1.1	20.5	5.0	13.9
White clover	90.3	11.5	42.2	1.5	25.1	7.8	13.2
Crimson clover	90.4	10.5	34.9	1.2	24.3	4.0	13.1
Bur clover	91.0	8.2	39.0	2.1	21.8
Serradella	90.8	11.4	38.6	1.7	24.3	7.4	26.3
Peanut vine	92.4	6.7	42.2	3.0	17.1	3.2	11.6
Sainfoin	85.0	10.4	36.5	2.0	23.7	5.0	14.7
Alfalfa	93.2	11.1	39.1	0.6	24.7	6.1	17.9
Hairy vetch	88.7	11.9	40.7	1.6	27.2	9.7	24.4

From the above table it will be seen that hairy vetch is remarkably rich in digestible protein and protein is **"the substance in foods that goes to build red flesh and blood and to make nerve and brain."** The chief component of protein is nitrogen, costliest of the plant foods, concerning which the reader will find some interesting facts in Chapter II of this booklet.

It is well to state here, however, that it is the **protein** in foods that costs so much, and it is **protein** that is generally needed so badly. Your cows need it when they make milk, your chickens when they make eggs, your young animals need it to make them grow. Unless there is an abundant supply of protein in the ration there will be few eggs, little milk and slow animal growth.

What nearly all farms are short of is this precious nitrogenous compound, protein. It is mainly for this reason that the vetches—with a greater nitrogen content than even alfalfa—are coming into such prominence as food for animals.

Its Chief Uses As Feed

Vetch is being largely used for pasture because, when sown in the fall, it makes a crop when green forage is scarce, before spring and summer grasses come in. Early fall growing, sown alone or with rye, barley, or oats, makes a pasture very valuable for live-stock during April and May, and if planted in August it will be ready in February and March. Just how long it will provide pasture depends a great deal on the seasons

HAIRY VETCH FOR SPRING PASTURE

and whether it is seeded lightly or heavily; also, whether it is desirable to have the vetch reseed itself or not.

The demand for early spring grazing crops is growing steadily, due mainly to the increasing interest in dairying and the beef industry. The regular pasture crops supply needed forage from early summer until autumn, and ensilage tides over late autumn and winter. But on nearly every farm there is a period of shortage of succulent forage from March until grass starts, and this period may be bridged over very profitably by growing vetch for spring pasture.

It is not a good plan to commence grazing the vetch too early. For best results the stock should be kept off the field until the vetch has made considerable growth. It also should be remembered that if the vetch is to reseed the land the stock should be taken off before they graze too closely.

While the principal means of utilizing hairy vetch as feed have been, thus far, in the form of soiling, hay and pasture, this rich legume is often profitably used as silage. The Michigan Experiment Station recommends ensiling it in alternate layers of corn. Considering its high protein content this practice ought to be a desirable one.

HAIRY VETCH FOR THE SILO

But while it is being proved that siloing hairy vetch can be made a profitable farm practice on many farms, in many different states, it is not rational to expect that it will ever compete, as ensilage, with the great silo crops, such as corn and alfalfa.

When sown alone, hairy vetch is not likely to prove a very popular soiling crop. It is difficult to cut. But if sown as a mixed crop, either with oats or some other kind of grain, it makes a very profitable soiling feed, and may be cut with a grass blade or mower and fed green to stock at most any stage of its growth.

FOR SOILING

In Europe where vetch is cultivated extensively for forage purposes it is regarded equal to clover in nutritive qualities. Over there it is sown in late summer or early autumn, and harvested the next year. If sown in spring it is cut the same year.

FOR HAY

There is no doubt but vetch makes excellent hay, though it is somewhat difficult to mow. When planted in the spring it will permit a large amount of grazing the first season and a full crop of hay the next. When sown in the fall with winter wheat for hay, the crop makes an excellent substitute for red clover and is ready to harvest as hay by the middle of June.

Vetch is often grown for hay in combination with oats, using one and one-half bushels of oats to 15 to 20 pounds of vetch to the acre. Many growers prefer smooth headed wheat to any other grain for sowing with vetch, more particularly where a hay crop is desired. They figure that there is less danger of the wheat being winter killed, and, moreover, wheat makes a valuable hay, and the two are most always ready to cut at the same time. This is the combination most used in Europe, where the greater part of our hairy vetch seed is procured. The wheat offers a support for the slender vetch plants and makes easy the harvesting of the seed and hay. When sown with wheat, 15 to 20 pounds of vetch should be used to the acre and three-fourths to one bushel of wheat.

The great feed value of hairy vetch hay may be better realized when we compare it with that of wheat bran. In the following figures taken from Henry's Feeds and Feeding the almost parallel analyses of the digestible nutrients of the two are shown:

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients		
		Crude protein	Carbohydrates	Fat
Wheat bran	88.1	11.9	42.0	2.5
Hairy vetch	88.7	11.9	40.7	1.6

From the above figures it can be seen that, pound for pound, vetch hay as a ration for livestock is very nearly equal in nutrient value to wheat bran. Other things being equal, it should be worth as much for feed, and the average price of wheat bran is about \$20 per ton. Furthermore, it is as palatable as it is digestible, and livestock as a rule eat it greedily.

The yield will run from 6 to 10, and sometimes, on very rich soil, from 12 to 15 tons of green forage per acre. The yield of dry hay, taken on this basis, would be 1½ to 4 tons per acre, the yield depending on the fertility of the soil.

In the June 28th (1912) issue of Hoard's Dairyman, ex-Governor Hoard, the well known authority on dairy subjects, says:

**HAIRY VETCH
FOR MILK COWS**

"Hairy vetch compares very favorably with alfalfa and clover hay as a feed for milk cows. The vetch hay is considerably richer in protein than clover hay and contains a little more digestible protein than alfalfa, but not enough to be considered in practical feeding operations. So far as com-

position is concerned, it is not very far from correct to say that alfalfa and vetch hay are practically the same."

Rye makes a satisfactory mixture with vetch, although it is more particularly recommended when pasturage or soil improvement is the chief end in view. Under most conditions, a better combination is wheat or oats. Yet rye and vetch as feed for horses can be successfully grown, as shown by the following letter from L. R. Johnson to the Breeders' Gazette, Sept. 11, 1912:

**HAIRY VETCH
AS FEED
FOR HORSES**

"We are pleased with our first experience with winter vetch. Our first cutting was made towards the end of May, while the rye was still green and the grains

unformed. The object was to have it succulent enough for horse feed. At this time the vetch had grown up to a height of about four feet and was intermingled with and supported by the rye. Although the horses had never before tasted vetch, they ate it with the rye with good relish. After this first cutting the vetch again began to grow and soon was in flower.

"Vetch is one of the legume family, all of which are **endowed with the power of storing the free nitrogen of the air in tubercles on their roots and thus enriching the soil without expense to the farmer.** Another point in favor of vetch is that it matures in less than a year, while red clover requires a full year and three or four months of the second year, thus extending over two seasons.

"Sow vetch in September and cut it or turn it under the next May. This would be in time to use the ground for planting corn. It grows as rapidly as the cowpea, but occupies almost exactly the months in the year which the cowpea does not. Thus it fills an unoccupied place."

As already stated, unless vetch is grown as a cover or green-manure crop, some grain should be sown along with it. Such a combination offers many advantages, chief among which are: (1) The grain supports the vetch vine, making the harvesting of the hay a simpler matter; (2) it is easier to cure vetch hay when there is mixed with it the hay of one of the grains; (3) the yield is increased by the addition of the grain, and there is greater certainty of obtaining satisfactory returns in either hay or pasture from the mixture than from vetch alone; (4) it is cheaper to sow vetch for hay, in combination with some grain, since it reduces the amount of vetch seed needed, an important item so long as the price of hairy vetch seed remains as high as it is at present.

The greatest care should be taken when handling the crop to prevent loss of leaves by shattering. When cut, the vetch should be at once cocked up in rather large cocks, so that the pods will be as little exposed to the sun as possible. Where there is room it is a good practice to remove the vetch to the barn to finish curing. Light should be excluded as much as possible without sacrificing the needed ventilation. After the hay is thoroughly cured it should be baled or closely stored in bulk.

Where a mixture of hairy vetch and grain is harvested the curing is more easily accomplished and with less danger of loss of leaves to the vetch.

In considering the feeding value of a crop we look first to the amount of digestible protein, or nitrogen, it contains, and then to its percentage of carbohydrates and fat. A crop which contains a low percentage of protein, like corn, for instance, is usually rich in carbohydrates; whereas, clover, alfalfa, and vetch contain a large percentage of protein, while their percentages of carbohydrates are relatively low. A proper combination of two crops—one rich in protein, the other rich in carbohydrates—results in a far more economical feeding for livestock than the use of either one or the other in too great proportion. The trouble is that in compounding rations for the various feeding purposes, it is, on most farms, **much more difficult and far more expensive to procure the necessary amount of nitrogen, or protein, than it is to procure the carbohydrates and fat.** This fact alone gives great prominence to the feeding value of inoculated legumes, such as alfalfa, the clovers, and the vetches; for all inoculated legumes are richer in nitrogen than cereal grains or hay from grasses; and the astonishing part of it lies in the fact that **all these inoculated legumes get their nitrogen from the air, while all other plants get their nitrogen by robbing the soil.**

When we consider the adaptability and usefulness of vetch for pasture, for a soiling crop, for hay and silage, when we learn that its food is richer in the costly nitrogenous nutrients than any other legume, if we except sweet clover, that it can be successfully grown in almost any state in the Union, we cease to wonder why it is that this marvelous legume is being recommended more and more for its feeding value.

CHIEF CAUSE OF FAILURE

The failures in vetch growing are mainly due to **lack of inoculation.** **No one should attempt to plant vetch without providing the necessary inoculation to produce the nodules on its roots.** Failure follows where vetch is not inoculated. Just what inoculation means is clearly shown in the following chapter.

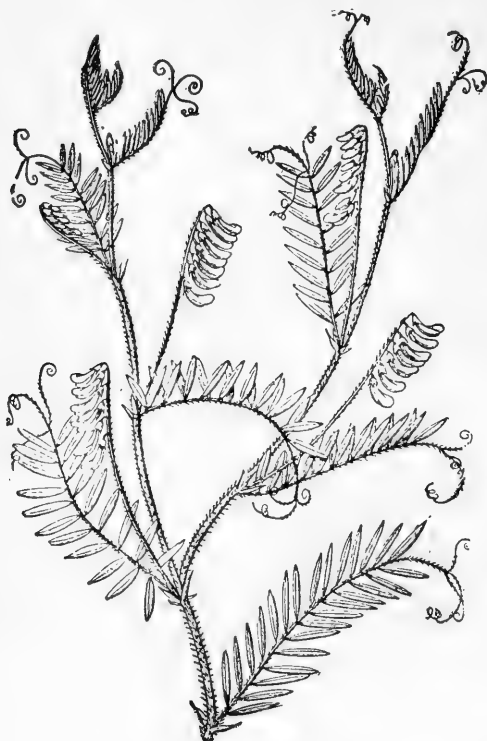
CHAPTER II.

Hairy Vetch King of Soil Builders

SOIL—HUMUS—TWO CHIEF SOURCES OF HUMUS—
THE HUMUS REQUIRED FOR SOIL BUILDING—NITRO-
GEN—LEGUMES—INOCULATED LEGUMES—LEGUME
GERMS—LEGUME GERMS VARY IN POWER—HAIRY
VETCH A GREAT HUMUS MAKER—A GREAT NITRO-
GEN-GATHERER—THE ROOTS OF HAIRY VETCH—ITS
MASSIVE FOLIAGE—HAIRY VETCH FOR WORN-OUT
SOILS—WIND-BLOWN SAND—PLOWING SANDY LAND
—THE ROLLER ON SANDY LAND—THE DISK HARROW
—THE LIGHT HARROW—PLANT INOCULATED SEED—
SEEDING SANDY LAND—BARN MANURE ON SANDY
LAND—LIME ON SANDY SOIL.

In the preceding chapter it was shown that hairy vetch is a forage crop that ranks very high in feeding value: It provides excellent pasturage at the most grateful time possible, early spring; it makes very good ensilage; it provides a soiling crop that is growing in favor every year; and it makes a digestible, palatable hay that is as rich and nutritious as alfalfa or clover. Nevertheless, the feeding value of this remarkable legume is of secondary importance when one realizes its **fertilizing value**. This latter value is so marked that many enthusiastic vetch growers give hairy vetch first place among all green-manure crops for increasing soil fertility.

As alfalfa is unquestionably the most valuable forage crop ever discovered, so hairy vetch, it is claimed, is the most valuable fertilizing



Hairy Vetch.

plant ever discovered. If this is true every farmer in America should know it. Therefore, let us ascertain, if possible, just where this plant gets its wonderful reputation for reclaiming poor or worn-out soil.

Hairy Vetch, it is claimed, will build up worn-out soil better, quicker and cheaper than any other green-manure crop; that it best supplies those two great needs of the soil, humus and nitrogen. That the reader may better realize what these claims imply, I will go over, very briefly, four essential factors upon which they are based: (1) Soil, (2) Humus, (3) Nitrogen, and (4) Legumes.

Soil is a mixture of inorganic and organic material. The inorganic part of soil is composed of rocks or mineral substances broken into more or less fine particles. The organic part is composed of decayed or decaying material which once had life in the form of vegetable or animal tissue.

SOIL

The inorganic particles, composed of rock and mineral substance, constitute by far the greater portion of the soil, being 95 to 98 per cent of sandy or gravelly soils, from 80 to 95 per cent of loams and clayey soils and about 80 per cent of muck or peaty soils. This inorganic material supplies the necessary mineral elements of plant food.

The organic portion of the soil furnishes the supply of nitrogen, that expensive element of plant food without which no crop can make any growth. It also supplies the other plant foods which are taken up in the growth of the plant or animal and which by their decay are returned to the soil in a form the plants can use. The organic portion of the soil also makes the mineral elements of the soil available by the action of acids upon the inorganic matter, the acids being produced by the decay of the organic matter.

From the above facts it becomes as clear as day that if you want to make your farm more fertile and improve its physical condition the essential thing to do is to establish and maintain a proper balance between the organic portions (humus) and the inorganic (mineral) portions of your soil.

It is a rare thing to find soil containing too much organic matter, especially if it is well drained. The trouble is usually if not always the other way, the amount of organic matter is too small. All run down, worn out, abandoned farms and sandy soils that are low in productiveness are lacking in humus. So, also, are all soils that have been misused by improper methods of cropping. The proper way, the only way, and **Nature's own way**, to restore all such depleted soils to a fertile condition is to feed them an additional supply of vegetable matter. In other words, the thing to do is to restore the proper balance between the organic and inorganic portions of the soil.

When speaking of humus I will refer to the organic portion of the soil although in the strict sense of the term this is not technically correct. Scientific writers usually make the distinction that humus does not refer to organic matter which is decaying in the soil but to that which is already decayed.

HUMUS

There are two methods of increasing the supply of humus in the soil; one is the application of barn manure, the other is to plow under some farm crop grown for that purpose. The last method is called "green-manuring". While stable manure makes very valuable humus, containing some nitrogen and at the same time exercising a most important effect upon the physical feature of the soil, it is not available in sufficient quantities, the demand greatly exceeding the supply.

TWO CHIEF SOURCES OF HUMUS

Not alone is the supply of stable manure insufficient but it is the experience of many farmers that, for reasons they are unable to define, certain green-manure crops, more particularly vetch, make a better quality of humus, bring bigger results, than stable manure.

Whether this be true or not, few farmers can economically secure stable manure in quantities that will suffice to keep up the supply of humus in their soil, to say nothing of any needed increase in the supply. It becomes evident, therefore, that green-manuring is the only available means of supplying soil with the humus it needs.

The kind of crop to plow under depends upon the needs of the soil.

THE HUMUS REQUIRED FOR SOIL BUILDING

When soil is naturally fertile and an increased supply of organic matter is the chief need, then any rank-growing farm crop may be used. But when the supply of nitrogen in the soil is small and an increased supply of both nitrogen and humus is the chief necessity, then some legume crop must be used. No other crop can increase the nitrogen supply. No other crop can return to the soil any essential element of fertility which it did not draw from it. The legumes are ideal humus makers. As a rule, they are succulent, juicy plants that decay quickly and are easily incorporated in the soil. What is more, they have deep, extensive root systems that bring up from below some of the mineral plant food which is present in the deeper layers of soil. Legumes grow luxuriously and provide vast quantities of vegetable matter which, when plowed under, quickly decay into plant-feeding, soil-building humus. This is the humus required when the end in view is increased fertility. **This is the kind, the only kind, of humus that increases the nitrogen supply of the soil.**

NITROGEN

Ever since the world has known anything of the chemistry of plants, nitrogen has been considered as the great essential component of plant food. It has always been, and is now, the most costly element in fertilizers. No one need tell the farmer how expensive nitrogen is. Too often has he dug down in his pocket to pay for it, either as nitrate of soda, tankage, cotton seed meal, guano, or dried blood, its cost ranging from 15 to 20 cents a pound.

But the progressive farmer is learning, thousands have already learned, that the most expensive nitrogen comes from the fertilizer bag and the cheapest nitrogen comes from growing some leguminous crop; he is learning that he can make his own nitrogen far cheaper and better, and at the same time supply his soil with humus by growing and plowing under some inoculated legume.

Today, no one, not even the fertilizer manufacturer, contends that nitrogen can be profitably bought in commercial fertilizers in quantities required by crops. There is only one economical source where it may be obtained in sufficient quantities and that is **from the air**. To get it from the air and put it in his soil the farmer must grow inoculated legumes.

The legumes are a group of plants which grow their seed in pods.

They embrace all the clovers, alfalfa, peas, beans, peanuts, lupines, sainfoin, serradella, and the vetches. These are the legumes most valuable to the farm. There is a multitude of others, of less value, both wild and cultivated, but these need not be enumerated here.

LEGUMES

For forage the legumes rank above grasses and other forage plants, being richer in nitrogen and producing a richer manure. As forage crops they help balance the food ration of man and domestic animals. The great bulk of farm products, either in grain or roughage, is from plants belonging to the grass family which produce plenty of starch and other heat-forming substances, but are deficient in protein or muscle-making foods. The legumes produce a large percentage of protein which, when used, tends to correct the otherwise one-sided ration. It is desirable to feed growing cattle alfalfa, clover, hairy vetch hay along with grain or corn, for the same reasons that human beings eat meat with potatoes. But with most farmers the profitable growing of legumes is not based upon their feeding value but more upon the fact that **all inoculated legumes are soil-builders and soil-renovators.**

This is because (1) they are largely tap-rooted and feed at greater depth than other plants, thereby working up heavy soils and rendering them more porous; (2) they bring certain mineral foods within the feeding area of more shallow-rooted plants and (3) their decaying roots leave humus in the soil upon which other plants can feed; (4) the legumes offer opportunity for a better system of rotation—not alone for reasons just stated, but because when brought into a rotation, they are not subject to the same insect enemies and fungous diseases of cereals and grasses; (5) **legumes not only provide great quantities of organic matter so much needed by all thin soils but (6) this organic matter, humus, is the means of adding to the soil large amounts of the one element of plant food that is most costly, most unstable, and most deficient in poor soils—nitrogen.** This added nitrogen comes from the air.

Although 75 per cent of the air in which all plants grow is nitrogen, no plants can use it except inoculated legumes. Inoculated legumes eat it and thrive on it and, better still, they store away a surplus of it in their roots, and when they are plowed under their total nitrogen is added to the soil.

INOCULATED LEGUMES

No one will appreciate this particular value of legumes unless he

gives it a little study. Let us take, for instance, the following six facts which Cyril G. Hopkins offers as a basis for the solution of the nitrogen problem in practical general agriculture:

"(1) To produce 100 pounds of grain requires about 3 pounds of nitrogen, of which 2 pounds are deposited in the grain itself and 1 pound in the straw or stalks.

"(2) In livestock farming one-fourth of the nitrogen in the food consumed is retained in the animal products—meat, milk, wool, and so on—and three-fourths may be returned to the land in the excrements if saved without loss.

"(3) When grown on soils of normal productive capacity legumes secure about two-thirds of their total nitrogen from the air and one-third from the soil.

"(4) Clover and other biennial or perennial legumes have about two-thirds of their total nitrogen in the tops and one-third in the roots, while the roots of cowpeas and other annual legumes contain only about one-tenth of their total nitrogen.

"(5) Hay made from our common legumes contains about 40 pounds of nitrogen per ton.

"(6) Average farm manure contains 10 pounds of nitrogen per ton.

Question: How many tons of average farm manure must be applied to a 40-acre field in order to provide as much nitrogen as would be added to the soil by plowing under $2\frac{1}{2}$ tons of clover per acre? **Answer:** 400 tons.

"Either method will furnish about as much nitrogen as would be taken from the soil by a 50-bushel crop of wheat, a 75-bushel crop of corn or a 100-bushel crop of oats per acre. The decision by the individual between live stock farming and grain farming should be based upon preference and profit rather than upon the erroneous teaching that farm manure is either essential or sufficient for the maintenance of soil fertility in this country.

"Bread is the staff of life, and many must sell grain. I do not advise all grain farmers to become livestock farmers; but I advise both grain farmers and livestock farmers to enrich their soils by practical, profitable and permanent methods. Both classes of farmers may secure new nitrogen—that is, they can positively increase their nitrogen supply by sufficient use of legume crops."

Another way to grasp the full value of inoculated legumes is to see what would happen if they did not exist. For instance:

A "good soil" contains from 2,500 to 10,000 pounds of nitrogen per acre. Let us call it 6,000 pounds.

A good crop (except inoculated legumes) takes from this store from 75 to 400 pounds of nitrogen, depending on the crop. Call it 200 pounds.

Question: How many crops could you grow upon "good soil" before the nitrogen became exhausted? **Answer:** 30 crops. At this rate, supposing there were no inoculated legumes to get nitrogen from the air, all soils would soon wear out and all plants would refuse to grow because of no more nitrogen for them to feed upon. Since human life is based on plant life, and plant life is based on nitrogen, all human beings would gradually starve to death. In other words, if the supply of nitrogen in the soil became exhausted, man, as well as animals and plants, would perish from the earth.

Luckily, legumes, when they are inoculated, have the power of tapping the vast sea of nitrogen that covers every acre of ground; they are able to take free nitrogen from the air and store it in the soil. How are they able to do this? They are aided by certain nitrogen-gathering bacteria which, for the present, we will call Legume Germs.

As already stated, inoculated legumes have power to obtain free nitrogen from the air. This is not strictly true. When a legume is "inoculated" it has certain germs living in its roots and it is these particular germs that really do the work of taking up free nitrogen and making it into plant food. Without these germs the legumes are as helpless as corn, wheat potatoes, etc., and must get their nitrogen out of the soil instead of the air.

LEGUME GERMS

Getting nitrogen out of the air is a partnership business—the Legume Germs furnish the capital, the nitrogen and the legumes furnish free house rent. Each partner helps supply the table board, the Germs furnishing all the nitrogen and the legumes furnishing the starch, sugar, and various mineral salts.

One of the most astonishing things about these nitrogen-fixing Germs is that they will not build their nitrogen homes any where but in the roots of a legume.

When they have built their homes in the roots of a legume then that legume is said to be "inoculated", for that is just what inoculation means.

If you carefully pull up an inoculated legume plant and examine its root you can see the nitrogen homes of the germs. Their homes look like little knots or warts. These are called nodules or tubercles.

The tubercles vary in size. You will find that on some legumes they are smaller than a pinhead, on others they are larger than a pea; it is all owing to the kind of legume. They are especially small upon some of the clovers, and large upon cowpeas and soy beans.

While the homes of the Legume Germs can be seen very easily with the eye, it is impossible to see the germs except by means of the powerful microscope. They multiply very rapidly and increase to enormous numbers. **Several million often live and work in the same house; in one tubercle.**

Another strange thing about these Legume Germs is this: While they all apparently belong to one family it requires a separate and distinct branch of the family to inoculate each different legume. Thus, there is but one branch of the family that will build their homes in the roots of red clover. And so in order to inoculate red clover it is

necessary that the red clover branch of the Legume Germ family build their homes in its roots. No other branch will do. Another branch will inoculate cowpeas, another soy beans, and still another vetch, and so on.

Before they can build their tubercles the legume germs must first penetrate the legume roots. And it seems that they differ a great deal in their ability to do this. Authorities agree that the germs also display differences in their ability to gather nitrogen from the air after their tubercles are built. This variable power of the germs is called **virulence**.

**LEGUME GERMS
VARY
IN POWER**

Germes with a high degree of virulence penetrate the legume roots easily and secure large quantities of nitrogen from the air. But germes of a low degree of virulence are feeble in this respect.

Soil conditions have a great deal to do with the virulence of legume germes. Ill-drained soils, or those deficient in humus, tend to rob the germes of their virulence, to the injury of the legume crops that may be grown upon them. On the other hand, under favorable soil conditions the virulence of the germes may be increased; soils in good tilth, well aerated and supplied with an abundance of moisture, **soils well provided with lime and humus, are friendly to germes and greatly increase their power as nitrogen-gatherers.** All of which goes to prove the great fundamental value of humus. The more we study the fertility problem the clearer becomes the fact that humus is the starting-point in furnishing added fertility to a soil and the finishing-point in maintaining its fertility.

In fact, it becomes clear that in order to restore a depleted soil to a fertile condition, or to build up any barren, sterile soil, the first thing to do is to remedy the lack of balance between its organic and mineral portions by supplying more humus. If the **right kind of humus** is supplied not only will it improve the texture of the soil enabling it to hold more moisture and soluble plant foods, not only will it increase the energy of soil bacteria which in breaking down the humus also set free acids which dissolve other plant foods, not only will it increase the virulence of legume germes, but the **right kind of humus will absolutely solve the nitrogen problem.** This soil-making, soil-building humus can only be economically added to the soil by growing and plowing under an inoculated legume.

But there are many legumes and, in a general way, they are all soil builders and renovators; so the question naturally arises, which one is the best?

In determining this there is only space here to deal briefly with the

two chief factors most likely to influence us: the comparative amount of vegetable matter the inoculated legume will supply and the comparative amount of organic nitrogen it will assimilate from the soil and atmosphere.

In supplying these two great essentials, let us see if, among all the legumes, hairy vetch does not display great prominence.

Hairy Vetch

A GREAT HUMUS MAKER

A GREAT NITROGEN-GATHERER.

It is no exaggeration to say that organic matter is the life of the soil. The productive power of most farming lands is proportionate to the amount of organic matter in it.

Ordinarily the roots of a legume contain only about one-quarter or one-third as much vegetable matter and nitrogen as is contained in the plant above ground. This is why, when a legume is grown to increase the fertility of the soil, it is necessary to turn under the whole crop. By doing this nearly three times as much humus will be added as compared with the manure which would result from feeding the crop since about two-thirds of the organic matter in feed is decomposed in the animal.

After the soil has been brought to a fairly fertile condition the humus and nitrogen supply can be maintained by the growth of inoculated legumes in short rotation. This can be done even when the legume is cut for feed, provided the manure from such feeding is returned **without loss** to the soil. Since, through leaching in the soil and in the management of the manure there is a gradual, unavoidable loss of the elements phosphorus and potash, it may be necessary, under certain conditions, to add these elements from time to time.

The value of any particular legume for green manuring purposes depends chiefly upon how heavy a growth it will make in a given time on a given soil and the total nitrogen which it will gather from the air.

In Popular Bulletin No. 32, written by R. W. Thatcher, Director of the Washington Experiment Station, there are certain analyses reported showing the percentage of nitrogen in various legumes. These analyses show the **greater fertilizing value of hairy vetch**—based on the market value of nitrogen it adds to the soil—even when compared with such great soil builders as alfalfa and red clover. The following is from Mr. Thatcher's bulletin:

"The actual gain in nitrogen through any leguminous crop may, of course, be obtained by multiplying the weight of crop-

produced by the percentage of nitrogen which it contains. It was in order to ascertain the percentage of nitrogen in the various legumes which were being experimented with that the analyses reported below were made.

NITROGEN CONTENT OF VARIOUS LEGUMES

"The samples for these analyses were taken from adjacent plots where each legume was given equal conditions of soil, moisture-supply, etc., for its growth. It is believed, therefore, that the figures in the table show the comparative nitrogen-gathering capacity of the different crops. The percentages in each case are computed in dry weight of samples.

CROP	Per Cent Nitrogen in Dry Matter			
	Tops	Roots	Nodules	Whole Plant
Sainfoin	1.92	0.90	1.60	1.85
Tangier Pea (<i>Lathyrus Tingitanus</i>).....	3.63	2.47	4.00	3.50
Field Pea (<i>Pisum Arvense</i>).....	2.68	2.38	2.84	2.62
Giant Vetch (<i>Vicia Pannonicum</i>).....	2.05	2.24	4.56	2.10
Spring Vetch (<i>Cicia sativa</i>).....	2.61	2.54	5.09	2.58
Scarlet Vetch (<i>Vicia sp.</i>).....	2.46	1.71	4.82	2.28
Alfalfa (<i>Medicago sativa</i>).....	1.72	1.27	6.92	1.50
Red Clover (<i>Trifolium pratense</i>).....	2.30	1.91	5.97	2.18
White Clover (<i>Trifolium repens</i>).....	1.87	1.73	5.86	1.82
Hairy Vetch (<i>Vicia villosa</i>).....	2.96	2.45	5.07	2.80

GAIN OF NITROGEN PER ACRE AND MARKET VALUE

"The gain of nitrogen per acre to the soil, if any one of these crops be plowed under as a green manure, may be calculated by multiplying the percentage of nitrogen in the whole plant by the weight of dry matter produced on an acre. This weight of growth will, of course, vary extremely in different seasons, on different soils, and with different cultivation. As examples of possible gains which may be made, the following table, computed from the yields per acre as given, may be of interest. The present market value of nitrogen in commercial fertilizers as sold in this State is about twenty cents per pound. The market value of the gain in nitrogen per acre by plowing under the average crop as shown is indicated in the last column.

CROP	Pounds of Nitrogen Per Ton	Probable Yield Per Acre in Tons	Nitrogen Gain Per Acre in Lbs.	Market Value of Gain in Nitrogen
Red Clover	43	3	129	\$25.80
Alfalfa	30	3	90	18.00
Field Peas	52	4	208	40.16
Tangier Peas	70	3	210	42.00
Hairy Vetch	56	4	224	44.80

"It is probable that the yields assumed in this table are higher than could be obtained in actual field practice. Certainly they are larger than would be obtained in the dryer sections of

the State. They are not larger, however, than may be secured under irrigation, or in those parts of the State where the annual rainfall is heavy. Not all of the nitrogen shown as gain, in the above table, would be net gain in every instance. On soils rich in nitrogen, the crop takes only a part of its nitrogen from the air, securing a considerable proportion from the soil itself. Probably, the poorer the soil is in nitrogen, the greater the proportionate gain in nitrogen from the air. The net gain is, therefore, likely to be greatest in those soils which are in greatest need of nitrogen."

The figures shown in the above table are in accord with the claim of the Agricultural Department, that an acre of inoculated hairy vetch plowed under has a fertilizing value, based on what its equivalent in commercial fertilizer would cost, of from \$20 to \$45.

Among many other things that make hairy vetch so superior a soil-builder is its mass of fibrous roots penetrating the soil to a considerable depth.

THE ROOTS OF HAIRY VETCH

Seed sown at the Cornell Station on July 10 produced plants whose roots on November 1 were traced to a depth of 3 feet 8 inches in a tough, impervious clay.

Alfalfa and the clovers are considered great soil builders because of their ability to gather nitrogen from the air; but, as a rule, you will find ten nodules on the roots of a vetch plant to one on the roots of either alfalfa or clover.

Another thing, the vetch tubercles are fresh and active during open weather in the winter and very early in the spring, showing that its legume germs have remarkable virulence. In this respect hairy vetch very profitably differs from most of the other cultivated legumes.

So numerous and thick are the roots of hairy vetch they will plow up like heavy sod.



Roots of Hairy Vetch Showing Unusually Large Tubercles.

Another great feature of this wonderful manure plant is its massive foliage (See frontispiece). It is not at all unusual for it to go 20 tons to the acre. In fact, there is no other legume, unless it is serradella, that produces such a quantity of organic matter for plowing under. An ordinary, well-inoculated crop of hairy vetch will go 12 tons to the acre.

ITS MASSIVE FOLIAGE

At the Cornell Station a three months' growth of hairy vetch produced **6,824 pounds of air-dried forage per acre**. It contained **240 pounds of nitrogen**, 53 pounds of phosphoric acid and 52 pounds of potash. During the same period cowpeas produced **2,262 pounds of forage per acre**, containing **46 pounds of nitrogen**, 23 pounds of phosphoric acid and 19 pounds of potash.

The above shows the immense amount of vegetable matter and new nitrogen the vetch grower is able to plow under and feed to his soil. It is truly a remarkable humus maker, strong, hardy, able to grow where other legumes fail, with a tremendous ability to increase the nitrogen supply of the soil.

But hairy vetch has still other valuable qualities in its favor. These will be brought to the reader's attention when the profitable uses of this marvelous manure plant are specifically discussed.

Hairy Vetch for Worn-Out Soil

Lucky is the farmer who has not some field or portion of his farm that is worn out and practically worthless. In the older settled sections many entire farms have been sapped of their fertility until they no longer produce satisfactory crops. Some are worn-out and absolutely worthless.

All such soils can be built up and made richer and more productive than they ever were if special care be taken to till them properly and to follow a type of farming suited to the locality and soil.

But the first step that must be taken to put a worn-out soil on a paying basis is to increase its supply of humus. Soil, as we have seen, was originally built up by mixing vegetable matter with disintegrated minerals and stones. Why can not a soil that is poor or worn-out, chiefly because it lacks vegetable matter, be built up by the same process? An abundance of vegetable matter will restore the proper balance between the organic and inorganic portions of the soil, improve its texture, add humus and plant food, and increase its water-holding power.

This needed vegetable matter can be economically supplied only by plowing under some soil-building green-manure crop. This means a legume crop. And can there be a better legume for the purpose than hairy vetch? Can you find another soil-builder that has equal ability to withstand cold weather, to make rapid growth in the fall and spring months? Or one that has such a heavy mass of foliage to turn under? Or one that can quickly add so much humus and nitrogen to the soil?

No matter if the soil you are to build up is sandy, gravelly, or cold tough clay, you will find hairy vetch a profitable humus maker. If inoculated, it will always live up to its title, **King of Soil Builders**.

For Poor Sandy Soils

Another name for hairy vetch is **Sand** vetch. This name came from its ability to grow and thrive on poor sandy soils. On such soils, better than any other legume, it will supply the three things most needed: (1) **nitrogen**, (2) **fermentable organic material** to aid in dissolving the **mineral plant-food** in the soil and (3) **humus** to aid in increasing the **water-holding power of the soil**.

These three vital things are needed to build up all soils but they are needed **most** on light soils, and inoculated hairy vetch will **best** supply them. The losses of nitrogen are greater the lighter the soil, and, possibly, leaches more readily from sandy soils than from any other.

It was on worn-out sandy soil that hairy vetch got its reputation of being the King of Soil Builders.

In the first place it has the advantage of other legumes in being better able to grow and thrive on sand soils. It is hardier and more drought resistant. It will grow in practically all the states, and is rapidly increasing in hardiness, thus adapting itself to our winters. (For this reason native seed should be preferred to imported seed, since it has been found to be better able to withstand our winters.)

For badly run-down land and barren sandy soils, the farmer needs, above all else, a soil-building legume best adapted to such soils, and that legume is hairy vetch.

If you, who are reading this booklet, have any such land my advice is to **GROW INOCULATED HAIRY VETCH**. You will find that your sandy soil will respond quickly and gratefully. In a remarkably short time your worn-out soil will grow the same bountiful crops it grew when its rich, virgin humus, deposited by nature herself, first turned dirt into dollars.

One of the chief virtues of hairy vetch is that it makes sandy soils much less subject to the action of the wind. Wind storms occurring in the spring and early summer months often completely destroy the young vegetation, and corn, potatoes and other crops planted on hills are frequently cut more severely in a few hours by such storms than by a very heavy frost.

WIND-BLOWN SAND

A matted growth of vetch covering the ground like a "thick velvet carpet" makes sandy soil as immune from damaging wind storms as heavier soils.

When you start in to build up very sandy soil with hairy vetch do not make the serious mistake of plowing too deep. The soil is thin and light and what humus it contains is mostly within two or three inches of the surface. So begin by plowing but four or five inches deep and gradually increase the depth each year as humus and nitrogen are added to soil.

PLOWING SANDY LAND

After your land is plowed it should be gone over with a roller heavily weighted in order to pack the loosened soil and make it firm. This will hasten the rotting of the weeds, grasses and shrubby growths you have turned under and help supply moisture from below.

THE ROLLER ON SANDY SOILS

Do not use a spring-tooth harrow, as many do, to pull out roots and shrubs. Leave all such trash in the soil. Its decay means that much more humus, the very thing you are after. The disk harrow, to cut the trash up and leave it in place, is a far better thing to use. The disk, too, will easily dispose of any new growth that comes up between the time you plow in July and the time you seed to vetch in August or September.

THE DISK HARROW ON SANDY SOILS

The disk should not run more than about three inches deep and should be set at only a slight angle. If you have no disk, use a spike-tooth drag with the teeth slanting slightly backward.

You should use the roller again just before you seed to vetch and again immediately after.

After the roller has gone over the seeding you will find that the

THE HARROW ON SANDY SOIL

smooth surface of the soil offers but little resistance to the wind. This is apt to cause more sand to blow and evaporation will go on more rapidly.

You can prevent this to a great extent by following the roller with a light harrow. This will not only roughen the surface and lessen the blowing of sand, but it will also form a dust mulch and this will check evaporation.

Your sandy soil is now ready for the vetch. Make sure that your hairy vetch seed comes from a **reliable seed house**. (See page 74.)

PLANT INOCULATED HAIRY VETCH SEED

Before you plant see that your seed is **inoculated**. That you may realize the absolute necessity of proper inoculation, I give here a report of the comparative results from sowing inoculated and uninoculated hairy vetch seed, taken from the Alabama Experiment Station Bulletin No. 87.

"Yield per acre of hairy vetch with and without inoculation:

Hairy Vetch	Green Forage	Cured Hay
Not inoculated	900	232
Inoculated	9136	2540



Hairy Vetch and Rye on Jack-Pine (Sandy) Land Near Muskegon, Mich.
(This cut kindly furnished by The Practical Farmer.)

You can sow your inoculated seed alone or with rye. If alone, sow 40 pounds of seed per acre the first year. This is not too much for it needs to be seeded thickly. Many vetch growers use 50 pounds. Sow from 2½ to 3 inches deep with a two-horse drill. If sown with rye, use 25 pounds of inoculated hairy vetch seed mixed with 2 or 3 pecks of rye.

**SEEDING HAIRY
VETCH ON
SANDY LAND**

Sow any time in August or September. Early in its growth hairy vetch is very grateful for any moisture it can get. So if August is particularly hot and dry it may be well to plant in early September. The plant will grow slowly at first but if you have followed the above instructions carefully, you will see it spring up like magic after it once gets a foothold.

Hairy vetch responds quickly to barn manure. And since manure is a great humus maker, it will also help your sandy soil. You should

**BARN MANURE
ON
SANDY LAND**

apply the manure as a top-dressing on your growing vetch during the winter or early in spring. Spread it very **even** and **thin** so it will not choke out the vetch, and use nothing but well-rotted manure.

There are two kinds of lime. Which is best for your poor, sandy soil? One is caustic or quick lime, such as fresh-burned lime or fresh-slacked lime; the other is the natural form, such as limestone, marble, lime shells, and shell marl.

**LIME ON
SANDY SOIL**

First let us see what effects are produced by using lime on soils. The two principal effects are:

(1) **To correct the acidity of sour soils.** Many of the legumes will not live or will not thrive to any advantage even when their seed is inoculated, on soils that are very sour. Prominent among these are alfalfa, and the clovers (red, white, crimson, and alsike). These legumes fail in sour soil because their bacteria (legume germs) will not develop and multiply.

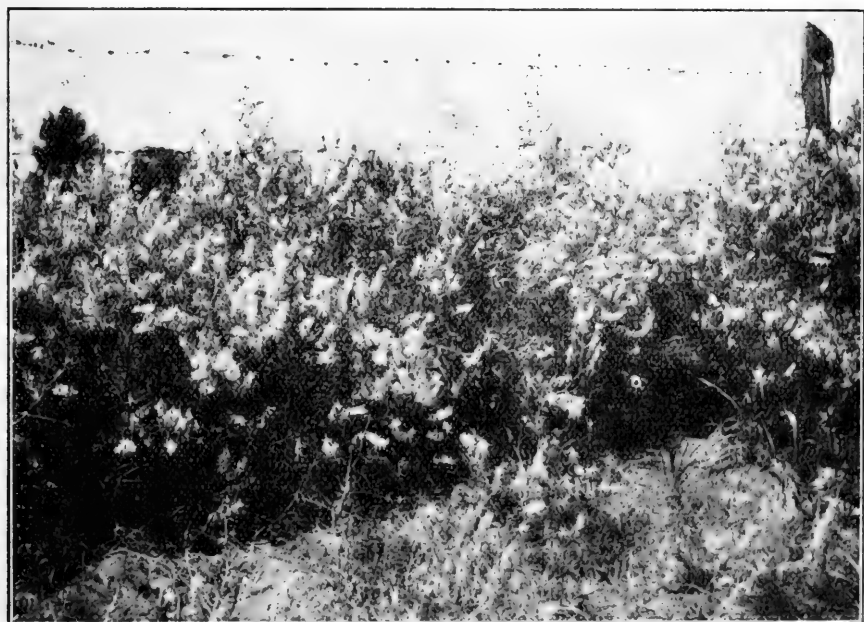
Any form of lime which can be thoroughly mixed with the soil will serve to correct the soil's acidity.

(2) The other effect produced by lime is the **decomposition of the soil itself.** The organic matter of the soil is destroyed with the liberation of nitrogen and phosphorus held in **organic form** and the mineral particles of the soil are broken up with the liberation of some plant food elements, as potash and phosphorus in **inorganic** form. This effect is produced by caustic or quick lime.

The second effect, the decomposition of the soil, is in all respects a **destructive** process. It destroys organic matter and reduces the stock of plant food in the soil. But you are looking for soil-building material for your sandy land, so never use caustic lime in any shape or form. It is beneficial on some soils, especially heavy, plastic clay and all heavy soils in which organic matter decays slowly.

Now let us look at the first effect of lime. The correction of soil acidity results in a **building-up process** for it helps inoculated legumes to grow. Most of the legumes are great lime feeders; they sicken and die in sour soil. So the question arises, what kind of lime and how much lime will you use on your sandy soil before you seed it to hairy vetch?

Answer: Use some natural form of lime, preferably ground limestone or marl. Always apply it on the surface so that it may dissolve and percolate **down**, sweetening the soil as it goes. Spread it on evenly **after** plowing, and then harrow it in. As to the amount, do not let this worry you on the start. One or two thousand pounds to the acre would be a great help. On the other hand, if you find it difficult to get this kind of lime right away, do not let this hinder you, but go right ahead and plant your hairy vetch. For unless your soil is **very** sour, it will grow and thrive, if well inoculated, without any applica-



Hairy Vetch Near Mississippi Experiment Station.

tion of lime at all. Alfalfa and the clovers and certain other legumes **must** have lime. The lupins and velvet beans are distinctly injured by lime, while the growth of **hairy vetch**, although lime will help it, is not seriously affected by more or less acidity in the soil. Another valuable asset in its favor, by the way.

Yes, Sir, grow hairy vetch on your farm if you have any worn-out land or poor, sandy soil to build up. It will work like magic.

On land so poor that corn is now almost a complete failure, hairy vetch and a careful treatment of the soil, as suggested above, will bring you **astonishingly big yields** of corn, potatoes, beans, buckwheat, strawberries, truck crops, etc.

The well-known writer, William C. Smith, of Delphi, Indiana, says:

"Hairy Vetch is the greatest soil-builder ever discovered."

With vetch and ditching I can reclaim any poor or worn-out soil."

"With it the American farmer can make his soil produce as it has never produced since it was rescued from the wilderness."

But hairy vetch, you must remember, makes no growth, no building material, it will not add an ounce of nitrogen to your soil, **unless it is inoculated.**

Just how to inoculate hairy vetch and all legumes, is told in the succeeding chapter.

CHAPTER III.

THE STORY OF "NITRAGIN"

THE DISCOVERY OF INOCULATION—WHY DOES VETCH ENRICH SOIL—ALL HEALTHY LEGUMES HAVE NODULES—BACTERIA—HOW AND WHEN LEGUMES ENRICH SOIL—SOIL TRANSFER—DANGERS OF SOIL TRANSFER—PURE CULTURE—"NITRAGIN"—"NITRAGEN" A GOOD INVESTMENT—WHAT "NITRAGIN" WILL DO—GERMS INOCULATE LEGUMES ONLY—HOW "NITRAGIN" IS APPLIED.

The Discovery of Inoculation

For ages man has known that vetch, instead of wearing out the soil, very often makes it richer and more fertile than it was before.

WHY DOES VETCH ENRICH SOIL?

Why? Nobody knew. The secret never became known until about 25 years ago, and what led to its disclosure was this: In 1886 a noted German scientist (Hellriegel) by experiments performed in the laboratory conclusively proved that when clover developed certain bunches or nodules on its roots

it could then make use of the nitrogen of the air for its own growth, and, furthermore, could add to the supply of this element of plant-food in that soil where it was growing. It had always been observed that a certain class of plants, the legumes, very frequently bore these little knots (nodules) on their roots.



Root of Sainfoin Showing Nodules.—
From Bul. of Ont. Dept. Agri.

Further observation showed that whenever these knots were found on the roots of legumes the plants were much more vigorous and of greater value as feed. Hellriegel and other scientists

**ALL
HEALTHY
LEGUMES
HAVE
NODULES**

also observed that the greater the size and number of nodules on the roots of plants the more vigorous was the growth of these plants; that those plants without nodules did not thrive well, but had a pale, sickly appearance.

This scientist further discovered that these tubercles were filled with millions of germs, or bacteria, and that these bacteria feed the legume plants all the nitrogen they need; that they then fill their tubercles full of nitrogen, and that they get their entire supply, not from the soil, but from the air. In other words, Hellriegel discovered that Nature herself has a way of unlocking nitrogen from its vast reservoir,

BACTERIA

the atmosphere, and putting it where it will enrich the soil. She does it by means of certain germs that live in the roots of legumes. Practically no other germs and no other farm plants but legumes have this wonderful power. It appears, too, that while there is but one species of nitrogen-gathering germs, yet each legume requires its particular kind, or strain. For instance, the germ that feeds vetch with nitrogen from the air, differs from the germ that feeds the clover, etc.

Thus Hellriegel taught the world why it is that vetch, clover, alfalfa and all other legumes enrich the soil. In partnership with these germs they tap the air for their nitrogen. They don't take it from the soil, the way wheat, corn and all non-leguminous plants must do. What is more, when a legume is cut or plowed under, its tubercles, of course, decay. What is the consequence? All the nitrogen stored up in the tubercles, together with millions of nitrogen-gathering germs, is distributed in

**HOW AND WHEN
LEGUMES
ENRICH SOIL**

the soil. This gives the soil enough nitrogen for the wheat, corn, oats, or any crop which follows. This is why you hear so much these days about plowing under legumes, or green-manuring, as it is called.



"NITRAGIN" Soil Germs Magnified
1,200 times.



Rod Forms of Bacteria from a
Fenugreek Nodule Magnified
about 1,500 times.

From Bul. of U. S. Dept. Agri.

But many writers are apt to forget, and few farm owners seem to know, that getting nitrogen out of the air and putting it into the soil is a partnership affair; that a legume must have tubercles filled with certain germs, or else it robs the soil, the same as wheat and corn do; that to plow under a legume which has no tubercles adds no more nitrogen to the soil than it took out of the soil. So far as enriching the soil with more nitrogen is concerned, you might as well plow under barley or buckwheat, or any other non-leguminous crop.

Soil Transfer

When you see a farmer haul a wagon load of earth from some distant farm where alfalfa has grown, and scatter it over one of his own fields in which he intends to plant alfalfa, you know now why he does it. Alfalfa stubbornly refuses to grow unless its partner, the alfalfa nitrogen-gathering germ, is in the soil. The soil must be what is termed inoculated.

With his wagon loads of inoculated dirt from some other farm, the farmer hopes to secure enough alfalfa germs to inoculate his own soil. This method of soil inoculation is called soil transfer.

Such a practice is laborious and expensive. You can see also that

it has dangers: the farmer is apt to secure more bad weeds than good germs; and so often does he transfer to his own clean land pests and parasites that breed plant disease, the Department of Agriculture repeatedly cautions against the practice, except where the soil to be transferred is positively known to be clean and whole-

DANGERS OF SOIL TRANSFER

some. The following quotations from Government Bulletins bear out the truth of the above claims regarding the soil transfer method of inoculation:

"The danger in this method lies in the possibility of introducing weed pests or plant diseases through the agency of the old soil.

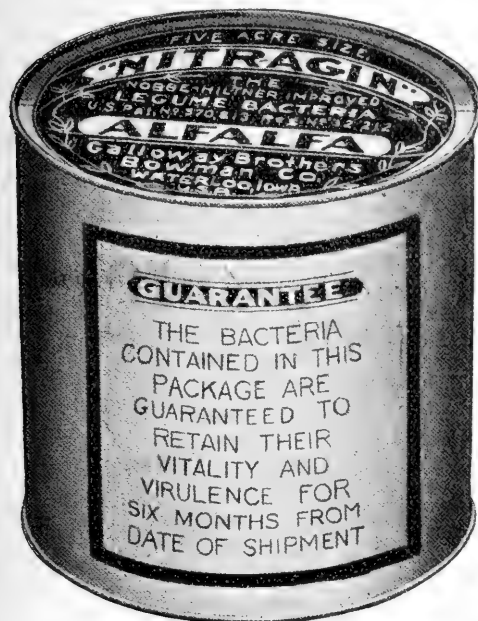
"The most scientific method of inoculating the clover field is to obtain a pure culture of clover bacteria and moisten the clover seed with it just before sowing."—From Farmers' Bulletin No. 323, published by the U. S. Department of Agriculture, May, 1908.

"The old method of importing the bacteria by distributing soil from fields containing them is not only expensive, but there is very great danger of spreading weeds and destructive crop diseases, as well as the desirable bacteria. Under modern conditions, therefore, it is wisest to depend chiefly upon the intelligent manipulation of pure cultures for inoculating leguminous crops.

"There are several insect and fungus diseases of clover to be avoided, and various diseases of beans and peas. There is also a disease of alfalfa, the 'leaf spot,' which is causing damage in some regions. These are only a few of many diseases liable to be transmitted in soils. The farmer should therefore be on his guard. The danger from such sources is by no means imaginary. The Department of Agriculture has had specific cases of such accidental distribution reported, and if the business of selling soil for inoculation is made to flourish by farmers purchasing without question 'alfalfa soil,' 'cow pea soil,' etc., there is every reason to believe that experience will demonstrate the folly of such haphazard methods."—U. S. Department of Agriculture, Farmers' Bulletin No. 315.

Pure Culture

In order that the world might get the full benefit of Hellriegel's great discovery, many scientists took up the study of legume bacteria. Instead of hauling soil from one field to another, why not breed strong, vigorous, nitrogen-gathering germs in the laboratory, and ship them straight to the farm? This was the question that first came to the minds of Nobbe and Hiltner, two noted German scientists. Years of study enabled them to put the idea into actual practice, and all literature on this subject gives them due credit for it. By means of their pure-culture method of soil inoculation, the farmer can procure any amount of legume germs he wants, and sow them along with his legume seed. By this method he incurs none of the dangers of soil transfer, and he inoculates his soil in less time, with less labor, and at less expense.



A Can of "NITRAGIN".

Nobbe and Hiltner named their product "NITRAGIN"

"NITRAGIN"
A TRADE-
MARK

(pronounced Ni-tra-gene) which name they registered all over the world

as a trade-mark. It was registered in the United States, December 6, 1898, as No. 32-212.

This product is now sold in all agricultural countries of the world. Last year (1912) in Germany alone, there were nearly a million acres of legumes inoculated with nitrogen-gathering "NITRAGIN" germs.

"Nitragin" A Good Investment

There is no one thing the farm-owner can buy that will bring him larger and more lasting returns than "NITRAGIN."

Nor is there a product anywhere that is indorsed and recommended by so many unbiased, disinterested and unquestionable authorities.

The product ("NITRAGIN") is—simply Germs, or, in other words, bacteria. These Germs are bred in a laboratory, after which they are packed in tin boxes (along with foodstuff to keep them alive), and then they are shipped to the farm-owner.

"NITRAGIN"
NOT A MYSTERY

There is nothing mysterious about this, no more than there is about making yeast cakes, nor, for that matter, than breeding cattle or hogs or sheep and shipping them to market.

In fact, this business has many features in common with the yeast maker's business. Both breed Germs and ship them to the market. Both send foodstuffs along to keep the Germs alive until they are used. Both try to breed healthy, strong, active Germs. Both breed specific kinds of selected pure-bred Germs for specific work.

The breeding of Germs has become as much a business, a science, an economic necessity, as the breeding of stock, and both are equally recognized as legitimate enterprises.

What "Nitragin" Will Do

Generally speaking, it will do mankind more real lasting good than any product on the world's market. This fact has been already demonstrated by progressive American farm-owners, numbering thousands, and every day hundreds are being added to the list.

Specifically, "NITRAGIN" Germs take nitrogen from the air and



Convincing proof of the effects of "NITRAGIN" germs on red clover. The plants are in the second year of growth. Plant to the left treated with "NITRAGIN"; that to the right not treated.

make it into a food for plants. Most farmers know that legumes are good green-manure crops. **Many** know that legumes help to enrich the soil. **Some of them** know that legumes bring nitrogen to the soil. But **how many know** that it is the legume GERM that has the power to take nitrogen out of the air and store it in the soil?

The slogan, "Legumes are the salvation of the soil," is wrong, for legumes without the GERMS are as big soil robbers as oats, wheat, corn or cotton, or any other non-leguminous plant, and this is really the meat of the whole subject. It is the GERMS that do the work. It is the GERMS that take the nitrogen out of the air. It is the GERMS that enrich the soil.

You must know, however, that the Germs that perform this wonderful work must have the co-operation of the legumes. That they

**GERMS
INOCULATE
LEGUMES ONLY**

live and thrive on the roots of legume plants only, which, of course, is the reason why agricultural authorities all recommend the growing of legume crops. But you will now understand that these authorities should have gone a step farther and have urged farmers to grow **inoculated** legumes. And the slogan should be "Inoculated legumes are the salvation of the soil," or, to be more accurate, "**Legume Germs are the salvation of the soil.**"

You will now understand and appreciate the slogan, "**'NITRAGIN' the Salvation of the Soil,**" since "NITRAGIN" is simply the trade-name for the GERMS that live at the roots of the legumes, and it is these GERMS that make the soil richer by taking nitrogen from the air and storing it up in the soil.

Scientists studied these germs or bacteria for years. They are still studying them, for these wonderful legume Germs are playing an important part in the solution of man's mightiest problem—"How can the fertility of the soil be maintained?"

NINE FACTS

Right here, let us give you nine facts which scientists have discovered concerning these great benefactors of Man—the nitrogen-gathering Germs:

(1) The Germs live in the roots of legumes and will not live in the roots of any other farm plants.

(2) These Germs make the legume plants healthier, hardier, deeper-rooted, quicker of growth, and give them greater food value, since they contain more nitrogen (protein) than Germless legumes.

(3) Legumes without these nitrogen-gathering Germs in their roots do not thrive well, and get all their nitrogen food out of the vegetable matter in the soil, the same as do oats, wheat, corn, etc.

(4) Alfalfa and some of the clovers wither away and die, unless these GERMS are in their roots; at best they never produce a crop worth harvesting.

(5) These Germs, in co-operation with legumes, build up worn-out land.

(6) Legumes without these Germs never add an ounce of nitrogen to the soil.

(7) These Germs and legumes maintain soil fertility.

(8) Legumes without these Germs, and all other crops (non-leguminous crops) rob the soil of its fertility.

(9) Each different kind of legume (vetch, alfalfa, red clover, crim-

son clover, cowpeas, soy beans, etc.) requires a different kind, or strain, of nitrogen-gathering Germs.

You should grasp the above facts firmly, for they are strong, vital, fundamental truths.

"NITRAGIN" is nothing more and nothing less than these nitrogen-gathering Germs, selected, cultivated, and pure-bred. Their scientific name all over the civilized world is the *Bacillus radiclecola*. Their commercial name all over the civilized world is "NITRAGIN" (pronounced Nitra-gene).

With the above facts in mind, ask yourself why you should plow under a legume crop for its nitrogen, unless it has these nitrogen-gathering Germs in the roots? Unless the crop is inoculated (or "NITRAGINED," as farmers are beginning to call it) the green manuring will not add an ounce of nitrogen to your soil. It will only put back what it took out of the land.

You had far better plow under some crop the seed of which is cheaper than the costly legume seed.

But if you want a catch of alfalfa, clover, vetch, soy beans, etc., you must see to it that these legumes have "NITRAGIN" Germs in their roots.

If you want greater fertility, instead of less, increased value of your land, rather than decreased, you should green-manure and rotate with some "NITRAGINED" legume plant.

How "Nitragin" is Treated

A legume becomes "Nitragined" when its seeds are moistened with a mixture containing billions of the proper kind of legume, or "Nitragin," germs. Thousands of these tiny germs adhere to the surface of a single seed. The seeds are then spread over the floor to dry. When dry enough to handle, they are planted, along with their Germs, in the usual manner. (See pages 72 and 73.)

The method is simple and comparatively inexpensive. It is the common-sense, logical way of inoculating legumes. It is cheaper, easier, and surer than inoculating with wagon loads of borrowed legume earth and has none of its dangers. The "NITRAGIN" method is endorsed, recommended and encouraged everywhere by the highest agricultural authorities, including the United States Government, Experiment Stations, Soil Experts and Editors of best-known Farm papers. "NITRAGIN" meets the great agricultural need of the hour—greater soil fertility.

(The Galloway Brothers-Bowman Company of Waterloo, Iowa, U. S. A., is marketing this product in the United States and Canada. It is furnished to farmers at a cost of \$2.00 an acre.)

CHAPTER IV.

Other Fertilizing Uses of HAIRY VETCH

ORCHARD COVER CROPS—WHAT A COVER CROP IS
—WHEN TO SOW A COVER CROP—WHAT A COVER
CROP DOES—HUMUS FOR ORCHARDS—LEGUMES AS
COVER CROPS—HAIRY VETCH AS AN ORCHARD COV-
ER CROP—ON TOBACCO LANDS—FOR CORN—FOR PO-
TATOES—FOR COTTON—HAIRY VETCH IN ROTATION
—INOCULATION A VITAL NECESSITY

An orchard cover crop means any sort of annual crop which is planted among fruit trees during the summer, or early fall, and **plowed under** in the spring. It is grown solely for the benefit of the soil and the trees. A "catch crop," such as potatoes or corn, is different. When grown between orchard rows a catch crop may or may not benefit the land; it is grown mainly for itself, for what it will produce.

WHAT A COVER CROP IS

The name cover crop is derived from the fact that its seed, sown in late summer or early fall, results in a growth sufficient to cover and protect the ground during the winter. The cover crop is usually planted as soon as the trees have made their growth for the season; the growing cover crop uses the surplus moisture, and thus aids the trees to mature before cold weather comes on.

WHEN TO SOW A COVER CROP

A Cover crop should not, as a rule, be sown earlier than midsummer. The most thorough tillage can then be given early in the season, and the benefits of the Cover crop can be secured for the early fall and winter.

A cover crop performs two important functions.

(1) It directly improves the **physical** condition of the land: It holds the rains and snows until they have time to soak into the soil.

WHAT A COVER CROP DOES

It prevents hard soils from cementing or puddling.

It dries out the soil in spring, making early tillage possible.

It often serves as a protection from frost.

(2) A cover crop also improves the **chemical** condition of the soil: It adds humus.

It renders plant foods available.

It catches and holds some of the leaching nitrates.

And, **when the cover crop is an inoculated legume**, it takes nitrogen from the air and adds it to the soil.

The above shows a few of the **many** advantages of a cover crop. Each suggests pages of discussion for which there is no room in this booklet. What is better than any discussion is a close, careful analysis of the particular needs of a given soil.

All soils cannot be treated alike. All soils differ and are subject to different conditions. No one knows the nature and peculiarities of a given soil like the man who tills it, who comes in contact with it day after day. If this be true it follows that every orchardist should study out and solve his own soil troubles; in this vital thing, as in most other things of this world, he can best work out his own salvation. He should be able to decide for himself whether the conditions of his particular soil require a cover crop or not, and if so, what crop is best to grow. He will be better qualified to make this decision the more familiarly he acquaints himself with the amount of fertility in his soil, its available moisture, its physical qualities, and the climatic conditions that surround him. No one kind of treatment is best for all orchards.

Young and old trees differ in their food requirements. Young trees use their food supply in the formation of wood and leaves. They grow vigorously for the first two or three years and then, when the bearing period is reached, their growth is less rapid; a large portion of their food is diverted to fruit formation. The demands on the trees being different, the food supplied should be different in character. Young trees require a large amount of nitrogen, while bearing trees require relatively less nitrogen and more phosphoric acid and potash.

It has been estimated that the value of nitrogen, phosphoric acid and potash used up by an acre of apple trees in twenty years, in fruit, is \$147; in foliage, \$160; in wood, \$70; total, \$377. Many old orchards

not only make this big demand on the soil, but it is often compelled to furnish hay or grain, or to fatten lambs and pigs.

Five bushels of apples remove about 11 pounds of nitrogen, nearly 1 pound of phosphoric acid, and 16 pounds of potash. The leaves of a tree large enough to produce the apples contain 10 pounds of nitrogen, nearly 3 pounds of phosphoric acid, and 10 pounds of potash.

When studying the physical and chemical needs of his orchard the orchardist should see that it is well supplied with humus. Orchards,

HUMUS FOR ORCHARDS

the same as corn and wheat fields, lose their humus sooner than their mineral plant food. Without humus they become exhausted, worn out; they cannot provide even the mineral plant foods, for humus is the key that unlocks these elements, making them avail-

able. Moreover, where humus is absent the light soils become lighter and clay soils become lumpy. Commercial fertilizers will not fill the bill; **the final and only remedy is to provide humus by growing cover crops.**

The remarkable discovery that legumes have the power to take nitrogen from the air and add it to the soil has been a great boon for the orchardist as well as for the farmer. The

LEGUMES AS COVER CROPS

modern orchardist can quickly determine the kind of cover crop his soil requires. If it has a sufficient supply of nitrogen and plenty of humus, he uses some non-legume as a cover crop, such as oats, rye, millet and

buckwheat. Of these, buckwheat is one of the best, sown not for grain, but to be plowed under in the spring.

But, more often, the orchardist finds that his soil needs humus to feed the trees, and that nitrogen is needed to hasten their growth and to make the fruit plants grow more rapidly. When the nitrogen supply is not sufficient, the leaves become yellow, the trees have a stunted, starved appearance and do not make a normal growth of branch and leaf. Here is where the legumes, the nitrogen gatherers, come in. They furnish a plentiful supply of humus, they furnish nitrogen at lowest cost, and at the same time they provide all the other money-saving qualities that any non-leguminous cover crop can possibly supply.

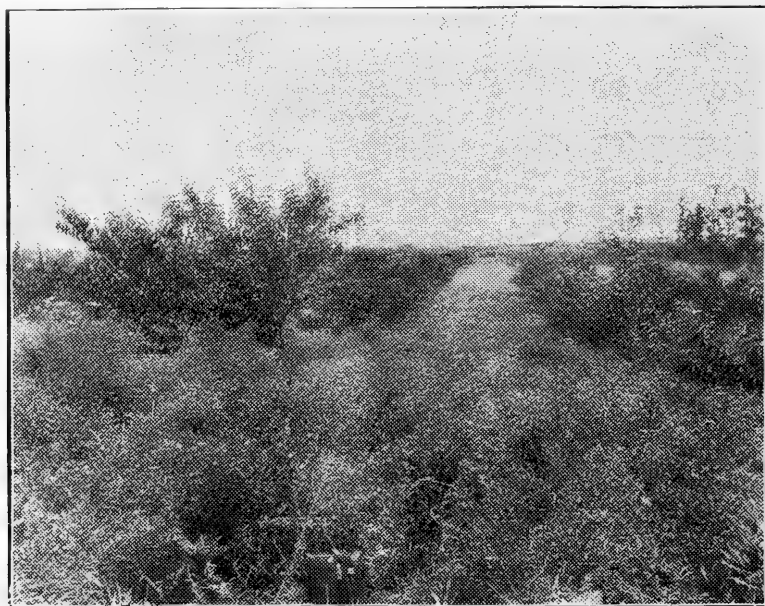
It is very plain that the expensive commercial nitrogen need not be applied to orchards, but that the nitrogen should be supplied by some inoculated legume which, after it has fulfilled its work as a cover

crop, is plowed under for the purpose of adding humus and nitrogen to the soil.

Hairy Vetch as an Orchard Cover Crop

Hairy vetch, when inoculated, ranks very high, if not first, among the more valuable legume cover crops for orchards. Its great manurial value is shown in Table 1, page 9. Another thing in its favor is that it makes a heavy growth by early spring, so that it can be plowed under soon enough to get the ground in shape for the thorough pulverizing of its surface to prevent evaporation of moisture during the long, dry summer. Crimson clover and cowpeas do not make good winter growth where the climate is very severe and frosts are frequent. These legumes make a rapid growth in late spring, when there is plenty of heat and moisture, but at that time it is often too late for plowing under because the soil is too dry for their quick decay. When winters are at all severe the hardier legumes, such as hairy vetch, red clover, bur clover, and Canada field peas, make the best crops for green manuring orchards.

The Cornell Station and many other scientific authorities, as well as a great number of successful orchardists throughout the country,



Hairy Vetch Used as a Winter Cover Crop in Peach Orchards, Wiggins, Miss. Light Sandy Soil, 30 Miles from Gulf of Mexico. (Reproduced by kind permission of The Practical Farmer.)

strongly recommend hairy vetch as a cover crop. It makes a remarkable cover, growing knee-high in a dense mat, and everywhere covering the ground. It is strong and sturdy and is not injured by the trampling during harvest. It is adapted to all soils. Its close mass of herbage kills out weeds and holds the soil. Moreover, inoculated hairy vetch will live through hard freezing weather and make a quick growth in the spring.

The enormous increase in the use of hairy vetch as a cover crop for orchards the past few years bears witness to its practical importance. Every orchardist and fruit grower should give it a trial on part, at least, of his orchard.

Wm. C. Smith, one of the best authorities on vetch in this country, writes:

"It has been found that the vetch plant is the best all around plant for orchard growing, because it grows luxuriantly, furnishes a large supply of organic matter, makes its growth quickly, and thus saves time and gathers nitrogen in vast quantities. And, then, it is an ideal orchard cover and green manuring crop to continue using during the life of the orchard, because it can be sown in the fall, when cultivation should cease in the orchard, affording a fine soil-covering plant, which prevents snow from drifting, and producing a large supply of organic matter for plowing under in the spring, when orchard cultivation should begin."

In the *Agricultural Epitomist* of February, 1912, Mr. R. A. Smith says:

"The department of agriculture of Washington states that a crop of vetch plowed under is worth \$16 to \$45 per acre as fertilizer. Its fertilizing effect is felt the entire season and longer. There is nothing fruit growers can better invest money in than vetch; it will play a great part in making over our old orchards and vineyards and bringing them into greater productiveness."

But it must be remembered that when vetch is recommended as a great nitrogen-gatherer, humus-maker and soil-builder, it is always assumed that the vetch is **inoculated**. If it is not inoculated vetch is forced to rob the soil for the nitrogen necessary for its growth just as corn or cotton; and like corn, cotton and the cereals, it becomes an **exhaustive** rather than a **restorative** crop, a **soil-robber**, instead of a **soil-builder**. To inoculate hairy vetch, as you have already learned, simply consists in placing a supply of the right kind of germs (Hairy Vetch "NITRAGIN") on the hairy vetch seed; the "NITRAGIN"-treated seed are planted, the germs come in contact with fine, hair-like roots of the plant, in which they build their homes, called nodules or tubercles. In these tubercles, where they multiply into millions, they take free nitrogen from the air, a part of which is fed to the plant, the remainder, the surplus, enriches the soil.

INOCULATION A VITAL NECESSITY

It is a wise precaution to inoculate the vetches in all instances. On land where they have not been previously grown, inoculation is a positive necessity.

Hairy Vetch on Tobacco Lands

No tobacco grower need be told of the tremendous loss of plant food that results from the soil lying bare for nearly nine months after the tobacco has been harvested in August, or thereabouts. There is leaching and drifting of the surface soil, to say nothing of the heavy fall and spring rains on sloping land, that may badly wash and gully the fields.

This leaching and washing of the soil involves not only a waste of the costly manure and fertilizer which the tobacco grower applies to his fields every year, but it is a **useless, preventable waste** of the soil's natural fertility. In time it will impoverish the richest kind of soil, and all the sooner, where one crop, like tobacco, for instance, is successively cropped, year after year.

The one, in fact, the only preventive is the right kind of cover crop. All tobacco growers know this, usually from bitter experience, and the question with them is which cover is best?

Any good cover crop will help eliminate the twofold waste, especially the loss of plant food. But the **ideal** cover crop will do **more than this**, it will do a thing of vital importance to the tobacco grower, it will not only prevent leaching away of valuable plant foods, but it will make the soil richer and more fertile every year, instead of exhausting it and wearing it **out**. This means bigger and better yields at a lessened cost of production.

RYE ON TOBACCO LANDS

Rye is often used as a cover crop. Is it the ideal one? Is it the money saver and money maker we are looking for? No, it comes far from filling the bill. On some lands it winter-kills badly. Then again on other lands you will find that it **dries out the soil** too much, especially if allowed to get too high in the spring. Another bad feature about it is that when plowed under it **does not decay quickly**, and this, alone, is enough to condemn it for tobacco lands. The slow decay of rye is **harmful**; it impairs the capillary action of the soil, leaving it too dry and loose for the young tobacco plants. In such a condition the soil yields up its plant food too slowly. No, rye is not the thing for

tobacco lands. In fact, where it makes a strong growth in the spring it may do more harm than good.

Many clovers and other legumes have been tried without much success. Failure has been due chiefly to the fact that **most** of these crops require **two seasons to reach their full development**. This, of course, is a great handicap. The ideal cover crop should be sown in August or September and be ready to be plowed under about the first of May. Then, again, tobacco growers in the more northern regions, particularly in Connecticut, complain that the clovers, in many instances, have winter-killed after a good stand was secured. Others complain that in many cases it is difficult to get a good stand in the fall.

CLOVER FOR TOBACCO LANDS

While there is no doubt but what, if proper precautions were taken and the seed well inoculated with "NITRAGIN," the danger of winter-killing would be greatly lessened and a good catch insured, the fact remains that the clovers make too slow a growth to ever become of great value as tobacco cover crops. Their place is in rotation with tobacco, not as cover crops.

Are we not already sufficiently familiar with the qualities of hairy vetch to see that it is pre-eminently fitted to fill the bill as a tobacco cover crop? Is it not the ideal money saver and money maker for which tobacco growers for years have been looking? Many tobacco growers will agree that this is true. Many of them have discovered the fact from personal experience, and their number is increasing all the time.

HAIRY VETCH THE IDEAL COVER CROP

Here are the assets in its favor. Can any other crop compete with it? Hairy vetch is a hardy plant that resists cold, heat, and drought. It covers the ground with a heavy matlike growth, which makes it an ideal preventive of erosion from wind or water and leaching of plant foods. When plowed under it decays rapidly. It occupies the land during **fall, winter** and **spring**. Then add to these ideal qualities the crowning fact that hairy vetch is a great humus maker and nitrogen gatherer, and its advantages over any other cover crop becomes pretty clearly established.

HAIRY VETCH

on Wisconsin Tobacco Lands

Writing on cover crops for tobacco, E. P. Sandsten, Horticulturist of the Wisconsin Experiment Station, says in Bulletin No. 124, of that station:

"In planning tobacco experiments it occurred to the writer that cover crops might be used as a means of partially maintaining the fertility of the tobacco lands and improving the physical condition of the soil. * * * The crop used for this purpose was hairy vetch (*vicia villosa*). This plant belongs to the legume family and is perfectly hardy. It was sown the last week in July, at the time when the tobacco plants were cultivated for the last time. An examination of the fields in November this year showed that the vetch had completely covered the soil where the tobacco stood. Being hardy, the plant will keep on growing until stopped by a heavy frost, and remain green during the entire winter, and start to grow again early in the spring, forming a dense mat of green herbage, which can be plowed under in time to use the land for another crop of tobacco. Not only does this plant furnish protection for the soil during the winter, and yield a large amount of vegetable matter, thus improving the physical condition of the soil; but like other legumes, it is capable of assimilating atmospheric nitrogen, by the aid of bacteria which live on the roots, and which make it available for the plant, thus being a soil improver and fertilizer at the same time.

Vetch on Kentucky Tobacco Lands

The following is quoted from the twenty-second annual report of the Kentucky Agricultural Experiment Station for 1909, in which green manure crops are discussed:

"Leguminous crops are valuable aside from the nitrogen and humus they add to the soil. Like clover, most of them root deeply and bring up the mineral elements of fertility from the lower depths of the soil, and when they are turned under, this matter is left in available form, and in reach of the more shallow-rooted crop. * * *

"It has been stated that the legumes are enabled to use the nitrogen of the atmosphere through the agency of bacteria living on the roots of the plant. The bacteria in some way, through their activity and multiplication, produce nodules or tubercles, little growths very much resembling warts. In the absence of nodules, it is safe to assume that the plant is getting its nitrogen from the soil rather than from the atmosphere."

Vetch on Connecticut Tobacco Lands

Perhaps the most interesting report and most valuable experiments with hairy vetch as a cover crop for tobacco fields have been conducted in Connecticut. The Bureau of Plant Industry, United States Department of Agriculture, Circular No. 15, was written by T. R. Rob-

inson, Assistant Physiologist, Soil Bacteriology Investigations. We quote some of the results reported in that circular:

"In connection with the introduction of a leguminous cover crop of tobacco lands in Connecticut it became at once desirable to know to what extent such a crop would lessen the need for fertilizers, especially those supplying nitrogen. Many experiments, mainly based on analyses of legumes, might be cited to show the amount of nitrogen which legumes furnish to a succeeding crop. * * *

ADAPTABILITY OF HAIRY VETCH TO TOBACCO FIELDS

"Mr. A. D. Shamel, of the Bureau of Plant Industry, published in 1905, in co-operation with the Connecticut Agricultural Experiment Station, the preliminary facts in regard to 'a new and valuable cover crop for tobacco fields,' namely, Russian or hairy vetch (*vicia villosa*). This legume was found to be resistant to cold, heat and drought; occupied the ground during the fall, winter, and spring; decayed rapidly when turned under; and enriched the soil by its ability to 'fix' or utilize the atmospheric nitrogen when properly inoculated—that is, when the bacteria were present to cause the formation of root nodules. Unless the bacteria were artificially supplied it was found that the desired inoculation was lacking or very tardy on the tobacco lands of the Connecticut Valley."

(Note that these scientific authorities declare that Vetch must be inoculated.)

WHEN TO SOW.—Hairy vetch is sown in the tobacco field at the time of the last cultivation, or very soon after the harvest. If sown while the tobacco is still standing, a cultivator should be run over lightly to cover in the seed. It is usually best not to cover the seed deeper than one to one and one-half inches. If buried deeper than this the seed may fail to germinate from lack of air.

If the vetch is sown after the harvest it will be found advantageous to disk the field or run over it with a spring-tooth harrow, the seed being broadcasted and then harrowed in.

Hairy vetch is a rapid grower and especially hardy, so that it is usually safe on the northernmost tobacco fields, to plant as late as the middle of September, while on tobacco fields further south the crop may be sown considerably later.

AMOUNT OF SEED TO SOW. A heavy seeding is usually desirable because a greater quantity of organic matter can be secured. It is, possible, however, to get very good results on most soils by seeding at the rate of 35 pounds to the acre of vetch, putting in a half peck of rye to give the vetch vines something to cling to in order to keep them off the ground. It may be desirable in certain cases to use as many as 50 pounds of vetch seed to the acre.

The soil-enriching properties of hairy vetch are never more clearly

HAIRY VETCH FOR CORN

and profitably demonstrated than when it is sown in corn at the last cultivation. When inoculated, it will grow rapidly on the poorest sort of sand land. By winter the ground will be completely covered with its matted vines, so there is no leaching of plant foods or washing of the soil. Its roots will be thick with nodules which the legume germs have **filled with nitrogen** and early in the spring, before any other kinds of grass or vegetation have begun to grow, the vetch plants will push out their summer foliage, and by the first of May they will be three and often four feet in length.

In its growth the vetch will assimilate considerable quantities of plant foods that have previously been applied to the corn in the way of fertilizer; also unused plant food which the cultivation and growing of the corn have made available in the soil, and which would otherwise be lost by leaching. The **worst thing about leaching** is that the nitrogen and mineral plant foods it carries away are **available**, and in the very best form as food for plants; otherwise, they could not be so easily carried away, and thus this loss leaves the soil poorer, with its remaining plant foods in a less useful form. To check this waste from leaching is one of the main reasons for growing a cover crop. It conserves soil fertility and cuts down fertilizer bills. The latter is a big item, especially where much costly manure and commercial fertilizers are used.

While the loss from leaching of the minerals, phosphoric acid and potash, which exist in fixed compounds in the soil, is very great, it is undoubtedly much less than the loss of nitrogen. Nitrogen is more **elusive**, as well as more expensive, than the others; in the soil today, tomorrow it may be on its way to the ocean. Vetch, as a cover crop, checks this waste of previous plant foods, and when plowed under adds **nitrogen**, which it has taken from the air, to the soil.

Thus, hairy vetch **saves** fertility. But its great function is not to save, it is to **create** fertility. When, at the last cultivation, it is planted in corn **this year** and plowed under next spring, the crop-producing power of your soil becomes greater; you grow more corn **next year**. On land where corn has been almost a failure, hairy vetch has built it up so that the first year it yielded 40 bushels to the acre. In fact, it is not unusual to hear vetch enthusiasts tell of corn after vetch yielding an increase of 80, 90 and 100 per cent.

One vetch enthusiast writes:

"I plowed under a fine crop of well inoculated hairy vetch

and planted to field corn. The corn produced over 90 bushels to the acre, an increase of over 100 per cent."

In his article, called "Tonics for Sandy Soils," printed in the November 23, 1912, issue of the Country Gentleman, J. Russell Smith very graphically tells the reader how to build up sandy soil:

"Sow vetch in your corn the last time you plow it. **Inoculate your vetch**, then let it alone for a whole season. Let it rest in the good old way. **That vetch will mat itself and cover the ground by the end of May**, it will die in July, and the second crop from its seed will come up in September and by plowing time the second year you will have one of the biggest sods that was ever plowed in Delaware. Vetch has lumps of nitrogen on its roots about as big as broom-corn seed, and lots of them. The corn that will follow this dose will make you think you have inherited money."

Every corn grower who is not growing 100 bushels of corn to the acre should give this soil-builder a tryout. He should begin with a few acres and by comparative tests see what it will do. If the seed is well inoculated, the writer believes that the experiment will not only prove that hairy vetch is the thing to fill the corn-crib to overflowing, but that it is one green-manure crop with which to build up soil-fertility for all crops.

Potato growers are learning the value of keeping the ground covered with growing crops over winter to be turned under the following spring as green-manure. An excellent practice is to sow hairy vetch in corn, to be followed by potatoes. The vetch will prevent the leaching of plant foods and fine particles of soil. It will clean and purify the soil and build it up. This is vital when we stop to think that the yield and quality of the potato depend almost directly upon the fertility of the soil.

HAIRY VETCH FOR POTATOES

We have seen that hairy vetch not only **saves** much of the available plant food already in the soil, but that, when turned under, it quickly **adds** a liberal quantity of available plant food, particularly nitrogen. Now, every potato grower knows that there is no farm crop in the world that is so grateful for available plant food, no crop that so readily respond to available plant food, as the potato.

Potatoes are great feeders on nitrogen and potash. They consume more nitrogen than corn. They also require considerable phosphoric acid. Hence it is that the amount of these essential foods that is

available in the soil, especially in sections of the country where the growing season is limited, is a matter of the utmost importance.

Here, again, vetch fills the bill.

Grow vetch and get more and better potatoes. Supplement the vetch, of course, with whatever mineral plant food your soil needs, whether phosphorus or potash, or both.

The Aroostook farmer in northern Maine is not satisfied unless he gets a yield of from 225 to 300 bushels per acre. His potatoes are grown on limestone soils, some strongly so, and it is his custom to grow them in a short rotation, so as to plant on clover sod. He will tell you that any rotation without clover, or some other thrifty legume, would cut down his enormous yields tremendously.

Clover, no doubt, is excellent, in fact, clover, vetch, or some other legume should always precede potatoes. In its Correspondence Circular No. 8, the Colorado Experiment Station says:

"Potatoes should follow potatoes only once, or possibly in rare instances the third time on very rich, mellow soil. Potatoes should not be planted in all more than two or three times on new ground until after some legume has been grown. **We have potato regions in Colorado—once producing potatoes by the trainload, that now produce none, because they could not, or would not, grow legumes."**

On sandy soils that are extremely deficient in humus, inoculated hairy vetch will grow and thrive better than any other legume, and give the potato grower bigger and quicker returns.

A potato crop needs no application of barnyard manure when a green-manure crop is turned under. Manure, as well as lime, often makes soil conditions that favor the development of the fungus which causes potato scab, and for this reason it should not be applied when preparing land for potatoes. Furthermore, many authorities, including the United States Department of Agriculture (Farmers' Bulletin 472), claim that the **turning under of a green manure tends to prevent the development of the scab fungus.**

Every potato grower anxious to grow bigger and better crops will find that the best previous crop is inoculated clover, or vetch. They root deeply, thus loosening and aerating the soil to a great depth. They add much nitrogen and humus and do not form a heavy sod, difficult to work up. They are usually free from weeds, which is important; the cleaner the ground, the lower the cost of production.

But as a green-manure for potatoes, especially on soil that is unfriendly to clover, hairy vetch is the ideal crop.

If you are a potato grower you **should** grow inoculated hairy vetch or clover. To keep in step with the big strides which the modern successful potato grower is taking, you **must** grow one of the legumes,

so why not pick out one that has so many remarkable qualities in its favor—hairy vetch?

HAIRY VETCH FOR COTTON

Hairy vetch is fast increasing in popularity among cotton growers, who have been compelled to turn to the various nitrogen-furnishing crops for assistance in their fight for soil fertility. This popularity is well founded. Planted in cotton at the last plowing it will take possession of the land when the cotton is removed and will continue to grow during the winter months, thus preventing the leaching away of the nitrates already in the soil, and adding new nitrogen from the atmosphere.

Vetch may be successfully grown on any soils of the South where cotton and corn grow and on soils entirely too poor for either of these crops. It will thrive better on thin sandy soil than cowpeas.

The following excerpt is taken from an article by Alex D. Hudson, in the *Progressive Farmer*, dated August 17, 1912:

"I have yet to find the kind of land that will not grow vetch successfully, always provided you inoculate for it. I have been growing vetch for a number of years, but never take in a new field without inoculating before sowing. I have made complete failures without inoculation on fields adjacent to the ones that had been growing vetch. I never seed vetch after October 20, and never use any but the hairy variety.

"We are running a three-year rotation, the farm being divided into three great fields, the rotation being cotton, corn, oats and vetch, followed by peas. This year is the first that cotton has come since the rotation began. We have cut out nitrogen entirely upon 60 per cent of our cotton, only using it where the soil was badly worn. The cotton is growing off fine and is now lapping in four-foot rows. There are fields adjacent, where the owner has simply run all cotton, that will not average one-third the size, and he has used a complete fertilizer. With another round of the rotation I will cut out all nitrogen on my corn. I have found it more profitable to grow vetch and oats than cotton, and at the same time the improvement to my soil is simply wonderful. **Any one that will follow this rotation will be able to cut down more than half of his fertilizer bill.**"

Hairy vetch and cowpeas prove a desirable mixture for a green-manure crop, since it permits a greater accumulation of nitrogen and humus than is possible when but one of these crops is grown. Where the mineral plant foods are not deficient these two crops will add 100 pounds or more of nitrogen to the soil per acre.

Prof. E. R. Lloyd, of the Mississippi Agricultural Experiment Station, reports an instance of a cotton grower who uses hairy vetch and cowpeas, in a manner as profitable as it is unique:

This cotton grower began with sowing hairy vetch broadcast in his cotton at the last plowing.

The following spring the old cotton stalks were left stand-

ing, the new rows of cotton being planted in the middles, which were bedded up in the usual manner.

When the vetch had made seed, the stalk cutter was run over the old rows and they were then plowed out and cowpeas planted in their place.

The field was then cultivated between the cotton and the cowpea rows.

In the autumn the vetch sprang up again and grew during the winter, the cowpeas being left to decay.

The following spring the cotton rows followed the old cowpea rows, and the vetch was left to seed on the old cotton stalks as before.

This method requires that the cotton rows should be about five feet apart, but the cotton grower who practices it assured Professor Lloyd that his **yield of cotton had doubled in the three years since the practice was started.** This practice is particularly called to the attention of those who grow cotton continuously on the same land, and this class includes the vast majority of cotton growers.

Whether the above practice appeals to you or not, if you grow cotton you owe it to yourself and to your cotton land to give inoculated hairy vetch a fair trial as a direct profit-making means of doubling your present yield, and at the same time increase, rather than decrease, the crop-producing power of your land.

Hairy Vetch in Rotation

Long before they knew why, many farmers learned from observation and experience that a rotation of different crops often increased crop productions, whereas one crop grown year after year on the same soil, diminished the supply of available plant food and decreased crop production. Today we understand fairly well the reasons underlying crop rotation, although it has some advantages not as clear to us as doubtless they will be some day.

There is one thing we all agree upon, whether we are farming in Maine or California, Minnesota or Texas, and that is that if we grow a hoed crop or a grain crop, year after year, on the same soil its organic matter gradually becomes less, and sooner or later, the soil becomes wornout and worthless. This leads us to a further agreement: the supply of the soil's organic matter must be kept up and this can only be accomplished by the use of green-crop manures and farm manure in a rotation.

Here is another vital point concerning crop rotation we should all

know, and that is that **in every rotation a shallow-rooted nitrogen-consuming crop should follow a deep-rooted nitrogen-furnishing crop.** In other words, some inoculated legume should supply the humus, the nitrogen, and, indirectly, the moisture required by the money crop which follows it. In fact, in every rational method of farming the legumes should be made to supply the needs of the non-legumes. The crops should follow each other in such succession that each crop will naturally pave the way for the next one that follows, or, at least, not place the succeeding crop at a disadvantage.

The crops in a rotation should be those that are well adapted to the particular soil and climate.

Cash crops, like corn, wheat, and potatoes, make a heavy draft upon fertility and need to be preceded in rotation by some thrifty legume that will not only abundantly supply them with humus and nitrogen, but, at the same time, build up and maintain the soil's fertility.

What better legume is there to feed the non-legumes in a rotation than hairy vetch? It commends itself, as we have already seen, in many practical, profitable ways, especially on badly run-down soils and wherever clover has ceased to make a thrifty growth.

On some soils it is possible to grow a wheat or a corn crop each year, if vetch is grown as a catchcrop. Unlike clover, vetch will thrive year after year on the same soil.

In some potato-growing sections it is becoming quite a common practice to grow potatoes year after year, seeding to hairy vetch after the removal of the crop in August, and plowing the vetch down early in the spring. This, and similar close rotations, necessarily demands that available plant-food be freely supplied.

Whatever crop rotation you employ, never forget this: your rotation must give prominence to at least one legume crop or your cash crops will soon wear out your soil.

Simply a rotation is not enough. Nor is it sufficient to grow clover or vetch and sell the hay; nor will it build up soil fertility to feed the legumes and waste the stable manure.

You must realize, if your yields per acre are diminishing, instead of increasing, that your soil must be fed the entire legume crop. It will not fatten on the crumbs from your legume table. It is hungry. Give it a good square meal. Plow under the legume and give your soil an abundance of organic matter it can easily and quickly digest; food that will make soil-flesh; food that will absorb three times its weight in water; food that will warm up the hungry soil and put new life and blood in its veins,

In every rotation, in every method of farming, you can dispense with many of the legumes all the time. You can dispense with all the legumes part of the time. But it is as sure as fate that if you expect to keep up the present productiveness of your farm (to say nothing of increasing its producing power) **you cannot exclude the growing of all the legumes all the time.**

Rotate, by all means. It cleans, stimulates, and encourages the soil; but in every rotation you should grow clover, vetch, or some other legume. Preferably, well inoculated hairy vetch, if your soil is hungry for moisture, humus, and nitrogen.

CHAPTER V.

**COMMON VETCH
and Other Vetches**

VARIETIES—WHERE COMMON VETCH THRIVES
BEST—IN OREGON—IN CALIFORNIA—IN SOUTHERN
STATES—IN NORTHERN STATES—SOIL REQUIRE-
MENTS—AS FEED—METHOD OF SOWING—TIME OF
SOWING—RATE OF SEEDING—HARVESTING FOR HAY
—HARVESTING FOR SEED—COMMON VETCH IN ROTA-
TION—COMMON VETCH SEED—ADULTERATION OF
VETCH SEED—OTHER IMPORTANT VETCHES—BLACK
BITTER — PURPLE — SCARLET — WOOLLY-PODDED
VETCH—SOME VALUABLE VETCH DON'TS.

The common vetch is an annual with much the same habit of the garden or English pea, but the stems are more slender and usually taller, growing 3 to 5 ft., or more in length. The pods of the common vetch are brown and bear four or five seeds. These pods pop open easily and discharge their seed.

**VARIETIES OF
COMMON VETCH**

There are numerous varieties of common vetch distinguished mainly by the color and size of the seeds, such as brown vetch, gray vetch, pearl vetch, etc. Then there are both spring and winter strains of common vetch; they are distinguished in European agriculture as spring vetch and winter vetch. Sometimes common vetch is called Oregon winter vetch due to the fact that so much of the seed is grown in Western Oregon, where it is usually sown in the Fall. To distinguish it from hairy vetch common vetch is also known as smooth vetch and sometimes it is called English vetch. The grey-seeded variety of common vetch is the one most cultivated in the United States.

Where Common Vetch Thrives Best

The most extensive area in this country where common vetch has become well established as a farm crop is Willamette Valley of Oregon, which lies between the Cascade Mountains and the Coast Range. This valley forms the largest agricultural region of Western Oregon. It is about 40 miles wide and 150 miles long. Common vetch is grown very generally over this entire area, replacing red clover to some extent as it seems to thrive better unless land plaster is used on the clover.

**IN
OREGON**

In Oregon the common vetch is seldom sown in the spring for spring-sown common vetch succeeds only where the summers are fairly cool; hot humid weather being injurious to it. Fall sowing gives best results. The yield is about 10 bushels of seed per acre. For seed it is sown either alone or with fall sown oats. When sown alone $1\frac{1}{2}$ to 2 bushels of seed are used per acre; with oats, a bushel of oats and a bushel of vetch are used. Wheat, rye and barley may be used in combination with vetch, but oats are preferable not only on account of the superior quality of oat hay, but from the further fact that where a seed crop is grown the oat seed can be easily separated from the vetch seed, while there is greater difficulty with rye, wheat or barley. It is often sown alone for common vetch has stiffer stems than hairy vetch. When it stands up, it may be cut with a binder unless the growth is very thick. If it falls down, as it often does, or if the growth is particularly heavy, the vetch is cut with a mower.

In the Oregon foothills where the drainage is good and the amount of winterkilling small, it is customary to sow 60 pounds of seed to the acre. If a mixture is sown, it varies from 30 pounds of vetch and 20 pounds of oats to double this amount. In the valley lands, where a certain amount of loss is likely from winterkilling, especially where the soils become wet, a larger quantity is sown. In combination with oats, 60 pounds of vetch and 40 pounds of oats are most commonly planted. The same rate of seeding is used as a rule whether the crop is grown for hay or for seed.

The chief market for Oregon vetch seed is right at home, for many farmers sow vetch while very few grow their own seed. Certain quantities of Oregon grown seed are shipped East every year, but as a rule most of the seed used in the East comes from Europe, because the European seed is usually much cheaper.

Common vetch is the most extensively grown green-manuring crop in California. You will find it grown throughout the orchard sections wherever green-manure crops are grown at all. It is adapted to quite varying conditions and succeeds in all sections of the state. It makes a good growth and does well on both the light and heavy soil.

<p>IN CALIFORNIA</p>

Orchardists in California are growing common vetch in preference to field peas which were largely grown a few years ago. There, it is also of much greater importance than the other green-manure crops, bur clover, fenugreek and Indian melilot.

This is not to be wondered at for vetch has certain qualities superior to the others, qualities that make it particularly suitable for green-

manure purposes. It not only yields a large tonnage, but grows well in the cool weather of winter, permitting it to be plowed under early in spring. Then again, when picking fruit and doing other work, the unavoidable trampling interferes but little with the growth of the vetch.

In Southern California common vetch when used as a green-manure is usually sown during September and the first half of October. Better results, however, are being secured with the earlier seedings and it is often good policy to sow during the first half of September. Sown this early the plants make a good growth before cold weather sets in and continue to grow during the winter. When sown late the plants often make but a small growth before the cold weather; they then make no growth, to speak of, until the latter part of winter when the warmer weather appears.

The rate of seeding varies from 40 to 60 pounds per acre. Forty pounds per acre is generally recommended, but the heavier seeding is giving much better crops and more than makes up for the difference in the cost of the seed. Early as well as heavy seeding is the practice among many growers and is bringing best results. Deeper seeding, too, has been found profitable where the plantings are early.

In Northern California, under irrigation, vetches should be sown about the first of October. They will then make sufficient growth to be turned under in February or March. This later season of planting in the Northern part of the state is desirable in both citrus and deciduous orchards on account of the heavy winter rainfall which prevents turning under the crop as early as in the Southern section. Vetch will make but little growth by February or March when sown in the Fall without irrigation.

Orchardists in California, and in every State in the Union, are growing more and more alive to the many values of green-manuring. These values are shown in the improved condition of the soil, the more thrifty appearance of the trees, in the improved quality of the fruit and the increased yield. Orchards with unthrifty trees, with sickly, yellowish-colored leaves soon brighten up and take on a new lease of life, showing a decided improvement in color, general appearance and vigor, better yields, following a few years of careful, intelligent green-manuring. Green-manuring lessens the chances of the trees becoming diseased. The California experiment station has demonstrated that gummosis of citrus trees is brought on by unfavorable soil conditions and that green-manures serve a useful purpose in remedying this disease. In orchards that have been green-manured any length of time this disease is seldom found.

As I have stated, green-manuring greatly improves the soil. Heavy

soils become open and friable and sandy soils more loamy. In California and elsewhere men handling orchards have learned that soils lacking in organic matter and humus wash easily, that they have little power to conserve moisture and that they are invariably "nitrogen hungry"; they are lacking in that precious plant food, nitrogen. They have learned that green-manuring their orchards will supply the soil with both humus and nitrogen providing the crop turned under is an inoculated legume with a heavy vegetable growth. Where orchardists have not learned this valuable lesson from actual experience it is taught them by the best authorities in the country. For instance, you will find this paragraph on page 11 of Bulletin No. 190, United States Department of Agriculture:

"A green-manure crop should be a legume wherever possible, in order to obtain the addition of nitrogen to the soil. It is also necessary that a good growth be made, in order to have a large quantity of organic matter to turn under and incorporate with the soil. **Along with good growth should be a heavy development of nodules on the roots, as this is believed to indicate great ability to fix atmospheric nitrogen.**"

In California statistics prove that of the green-manure legume crops commonly grown there, such as vetch, peas, burr clover, and fenugreek, the inoculated vetch returns the most organic matter and adds the greatest amount of nitrogen to the soil.

Common vetch is largely grown as a winter crop in the Southern States, usually with oats, rye, or barley. I don't believe that, as a rule, the yield is as great in the South as it is in the Pacific States where the average is about 2½ tons per acre. The reason for this may lie in the fact that in the south less seed is usually sown, about 40 or 45 pounds of vetch and 8 to 10 pounds of oats to the acre.

IN THE SOUTHERN STATES

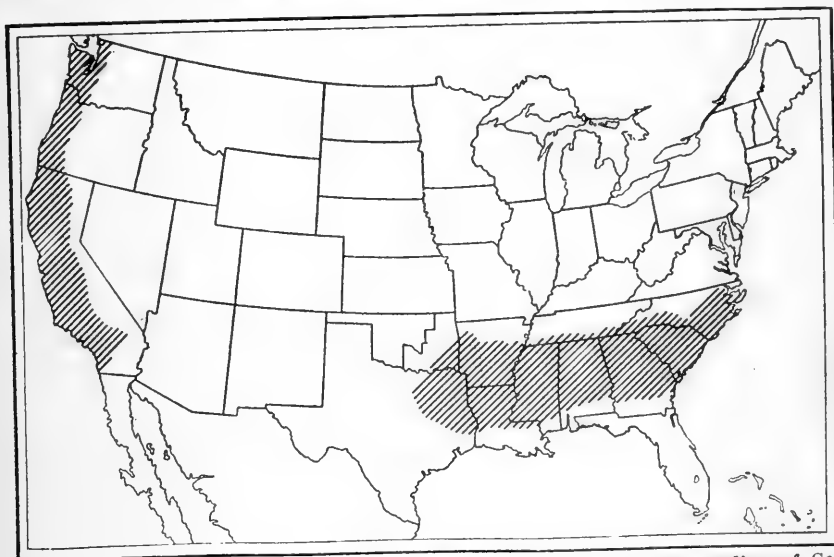
In the Southern States oats and common vetch should always be sown in the fall, October being the best month, though the planting may be delayed till the middle of December. For green-manuring early fall planting is recommended.

I don't believe that in the South the average yield of vetch seed to the acre has been estimated. Five bushels is considered a very low yield and 25 bushels a very high one. The average, I should say, is around 12 and 14 bushels.

In Georgia vetch has become an important crop especially in the Savannah River bottom near Augusta. There it is principally grown as a winter hay crop, usually with oats. The variety most used is the

common vetch, often called Oregon vetch since it is the same variety as that grown in Oregon. This hay commands a good price as feed for horses and other kinds of stock.

In other points in the South, including South Carolina, Alabama, Mississippi, Louisiana and Arkansas, common vetch is securing a stronger foothold every year. But it should be remembered that common vetch will not ordinarily withstand more cold than 15° above zero, Fahrenheit, while hairy vetch is so hardy it can be grown almost anywhere in the United States.



Map of the United States, Showing the Regions Suited to the **Fall Seeding** of Common Vetch. (From Bul. No. 515 of the U. S. Dept. of Agri.)

Common vetch succeeds wherever Canada field peas do well. Where the winters are severe it must be planted in the spring. To provide pasture the spring vetch is usually sown with some cereal, such as oats or barley. Wherever climate conditions enable it to grow successfully, common vetch is found superior to hairy vetch in providing soiling food and fodder, chiefly because it is more upright in its habit of growth and hence easier to harvest and, besides, it is less tough in the stems.

**IN
NORTHERN
STATES**

Some authorities recommend the use of spring vetch in the place of cowpeas, especially in the northern states where the pea-louse has been very destructive. It is sown in early spring and under favorable conditions it is ready to harvest before the first of July.

Like alfalfa, clover, and other legumes, common vetch prefers a well drained soil, it will not thrive in badly drained land. While excellent crops are grown both on sandy and gravelly soils, it does best in loams or sandy loams.

**SOIL REQUIRE-
MENTS OF
COMMON VETCH**

The seed bed for common vetch should be made firm. In Washington and Oregon the common practice is to broadcast the seed in oat or wheat stubble and go over it with an ordinary disk harrow, or where the land is fairly loose the seed is simply sown in the stubble with a disk drill. This method brings good results especially if the previous small-grain crop has been spring-sown and if the vetch is sown quite early in the fall. If, however, the previous grain crop was fall-sown and the vetch is planted rather late in the fall, the land usually becomes too compact and should be deep plowed and thoroughly worked. Common vetch is often planted in corn at the last cultivation or it may be drilled into potato ground without plowing if the potatoes have been well cared for and the soil is worked up fresh after the potatoes are removed.

In the South common vetch demands that more attention be paid to its seed bed. As is necessary, more or less, with all legumes, particularly alfalfa and clover, the soil should be finely pulverized. For spring grown vetches fall plowing should be the rule. For fall sown vetches it will depend somewhat on the preceding crop. The ideal condition is a clean, firm, moist, well-settled soil. Where following a hoed crop such as early potatoes it is enough to disk the ground deeply and then smooth it with a harrow. Following a cereal, the land should be plowed some time before seeding, especially if the weather be dry, and then to enable it to gather and hold moisture the land should be rolled and harrowed.

In Oregon and Washington many dairymen use common vetch for pasturage during winter, spring and early summer. It is eaten eagerly

**AS
FEED**

by all farm live stock. As a general rule, the vetch is pastured only when the ground is dry, not only to avoid packing the soil, but because both cattle and sheep are liable to bloat on vetch, especially in wet weather.

The vetches are much relished by all classes of live stock; in fact there are but few kinds of food that are equally suitable for the animals of the farm. Their fattening properties are of a very high order while for milk production they can scarcely be beaten.

Vetch and oats make an excellent forage, being very palatable and

highly digestible when in the best stage for feeding. This crop may be put into the silo and the silage, while a little richer than corn, will give about the same results.

Legumes, however, should never be put in the silo alone. They should be mixed with some other crop. Any plant very rich in protein develops a very strong and somewhat objectionable odor, and great care must be taken in the feeding or there is danger of the milk becoming tainted. For this reason it is best that the silage contain a mixture in order to counteract this unpleasant feature.

The hay of the common vetch is remarkably nutritious, as much so as clover and is relished even more; but it is easily injured by rain when being cured.

As a soiling food common vetch is also very suitable and is equally adapted to horses, cows, sheep and swine.

Common vetch may be sown either broadcast or by drilling. The old, perhaps the most common, method is to broadcast it although the

**METHOD
OF SOWING
COMMON VETCH**

use of the drill is increasing every year, especially in Oregon. It is plain that drilling is more economical, it saves seed, and some growers claim that it lessens winterkilling by favoring the deeper rooting of the plant, so that there is less injury from frost heaving.

Common vetch may be sown alone or with one of the small grains as a supporting crop. Where the crop is grown chiefly for hay it is

the common practice to sow the vetch with grain so that its weak stems may be supported and kept from lodging. The favorite combination is oats and vetch though wheat, rye and barley may be used. As stated before, oats are preferred because it is easier to separate them from the vetch seed. Oats that have stiff straws are preferred, such as Gray Winter and Black Russian. When grown for seed, vetch is often planted alone. Vetch seed should be sown about the same depth as cereals.



Common Vetch and Barley at Louisiana State Exp. Station.

The common spring vetch should be sown for forage just as soon as the ground is dry enough to be worked without injury. The common winter vetch ought to be sown long enough before winter to let it get firmly established before severe frosts set in.

**TIME OF
SOWING
COMMON VETCH**

In western Oregon and western Washington vetch is seeded in September and October, with the tendency to plant in the earlier month to reduce damage by winter-killing.

Some dairy farmers plant vetch at various dates so as to use it as a soiling crop. Sown with oats about October 1, it is ready to feed about the first of May; planted later, it can be cut about the first of June; and if early spring sowing is practiced, say in February or March, the vetch can be fed from June 15 to July 15. When cut early for soiling, a small second crop may be cut or used as pasture.

In Southern California, when used for green-manuring purposes, common vetch is sown in September, so that it can be plowed under by March.

In the East vetches are used extensively for orchard cover crops, being sown at time of last cultivation. For this purpose, however, the vetch most commonly used is the hairy vetch.

I have already given the reader some figures regarding the amount of common vetch seed to sow under stated conditions, but I'll set them all down here so that at any time he may have a definite place to turn and look for them.

**RATE OF
SEEDING
COMMON VETCH**

In Oregon when common vetch is sown alone $1\frac{1}{2}$ to 2 bushels of seed are used per acre. If with oats, 60 lbs. of vetch and 40 lbs. of oats are most commonly planted in the valley lands; in the foothills it varies from 30 lbs. of vetch and 20 lbs. of oats to 60 lbs. of vetch and 40 lbs. of oats.

Some growers plant as high as 2 bushels of vetch to the acre when grown for seed alone. Such thick plantings are apt to stand up better, but it is doubtful if they result in any material gain.

In California, when common vetch is planted as a green-manure crop, the usual rate of seeding is 60 lbs. to the acre, but as low as 40 lbs. are often used.

In the South the amount of vetch seed sown per acre is less than on the Pacific Coast, probably on account of the higher price. The average amount is about 45 lbs., or 3 pecks, to the acre. Sown with oats, about 40 lbs. of vetch and 8 to 10 lbs. of oats are sown to the acre.



Cutting Vetch with Mower. Cut Swath Thrown on Uncut Vetch.

For hay, vetch should be cut from the period of full bloom to formation of the first pods. It may be cut with an ordinary mower with a swather attachment. After cutting, the vetch should be bunched with a horserake and then shocked with pitchforks. This handling should be done before the vetch leaves are dry. It should be allowed to cure in the shocks several days, and where possible, hay caps should be used, especially if rainy weather is feared.

HARVESTING FOR HAY

It is sometimes well to pasture fall-sown vetch in the spring so as to bring the haying season somewhat later and also to prevent heavy lodging. This is frequently done in western Washington and Oregon.

As already stated, both common and hairy vetch shatter their seed badly, for the reason that when the pods become ripe they pop open easily. This, in part, accounts for the low yield of seed. If the seed is to be saved it is necessary to handle these crops with extreme care.

HARVESTING FOR SEED

As a rule it is best to cut vetch for seed just as soon as the lower pods are ripe, at which time the upper pods will be fully formed and the plant will be

carrying its maximum quantity of seed. If it is cut later than this more seed is likely to shatter, while earlier cuttings will result in considerable immature seed.

Some growers use an ordinary grain binder, especially if the vetch stands up well or when it is grown with a supporting crop, such as oats. When thus harvested, the crop is put in shocks similar to grain shocks and allowed to remain until threshed.

When the cured vines, or bundles, are hauled to the stack or threshing machine, tight-bottomed beds are used so as to catch the seed that shatters. In threshing, the concaves are removed, the cylinder is run at slow speed and as much wind used as possible to clean the seed.

Perhaps the most common way of harvesting vetch is to use an ordinary mower with a swather attachment. The swather, which is attached to and behind the sickle bar, rolls the vetch in a swath. Whatever method is used in cutting, it is very important to handle the crop rapidly and as little as possible after it is cut.

Common vetch is nearly always grown in rotation. In Oregon and Washington it is usually grown after spring-sown oats. It is also used in rotation with potatoes and corn.

<p>COMMON VETCH IN ROTATION</p>
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In the Savannah River bottom near Augusta, the most famous vetch-growing section in the South, the crop is mostly grown in rotation with Johnson grass; especially on valley lands where the Johnson grass volunteers. Vetch hay has a fine reputation at Augusta where it sells at top prices for horse feed. The vetch, usually mixed with oats or other small grain, is planted in October and harvested by the middle of May. After the vetch crop is removed, the Johnson grass, more or less mixed with other grasses, begins to grow and commonly yields two hay cuttings during the season. The vetch improves the growth of the grass, helps keep down weeds, and at the same time makes a fair cutting of very fine hay.

Where Johnson grass does not permanently occupy the land it is not advisable to sow it, as it is extremely difficult to eradicate. In this case various summer crops can be grown in the rotation, such as sorghum, cowpeas, sorghum and cowpeas, soy beans, etc.

As a rule, the vetches should not be sown in rotation with wheat, as they tend to volunteer and their seed is very difficult to separate from wheat. If grown in rotation with wheat they should not be al-

lowed to mature their seed, but where this is done the vetch should be followed by a cultivated crop before wheat is again planted.

OTHER IMPORTANT VETCHES

Woolly-Podded Vetch

Both in appearance and in agricultural value the woolly-podded vetch closely resembles hairy vetch. It is equally hardy and much earlier, maturing even earlier than common vetch. It differs from hairy vetch in having nearly smooth leaves, purple flowers, and hairy pods. Its flowers are very fragrant and attract bees in great numbers.

In California and western Oregon this legume often shows a stronger growth during the cool weather of early winter than the common or hairy vetch, but not so strong as the purple or black-bitter vetch. When inoculated it succeeds splendidly and on account of its earliness and good seed-bearing qualities it has some advantages over hairy vetch. It stands trampling well and for sowing without irrigation in deciduous orchards it may be of special value. Except that a little less seed may be used it is handled the same as common vetch.

Scarlet Vetch

This plant is the most erect growing of the annual slender-stemmed vetches. While it usually withstands the winters of the Pacific Coast and the Cotton States, it is even less hardy than the common vetch.

It is a rare thing for scarlet vetch to produce seed in large quantities; furthermore its pods shatter very easily, so that the seed is comparatively expensive.

Like the other vetches, it is drought resistant and from spring sowings has succeeded better in the semiarid regions than any other vetch except the purple.

Purple Vetch

This legume, often called black-purple vetch, is a smooth annual with dark purple flowers. Its seed habits are excellent and it can be grown as cheaply as common vetch although it is not so hardy.

On the Pacific coast and in the South this species has proved very promising. In the semiarid regions larger yields have resulted from spring plantings than from any other vetch.

The time and manner of seeding this crop are much the same as with common vetch. As the seed is a little smaller, however, a smaller quantity may be used. To insure profitable returns the seed should be well inoculated.

Black Bitter Vetch

This legume is forging to the front as a green-manure crop, more particularly in California. This is because of its upright growth which gives it a big advantage over most other vetches and its superior growth during the cool weather of early winter.

Its seeding habits are also better than those of other vetches. Its pods shatter but very little, which makes the harvesting of the seed much easier.

It has still another advantage over the common vetch in that its fibrous roots penetrate deeper. On the other hand it is not so readily eaten by live stock and it requires a slightly greater quantity of seed when planted. From 60 to 70 pounds per acre is recommended. Aside from this, the crop is handled like common vetch. **When inoculated,** it produces splendid crops. It is predicted that under California conditions it will in time replace other green-manure crops to a great extent.

A REVIEW OF MAIN POINTS

THINGS TO REMEMBER

PREPARATION OF THE SOIL

(1) If plowed at a season of the year when the loss of moisture is apt to be a set-back for the new seeding, go on and drag the field as soon as possible after plowing to form a surface mulch that will prevent excessive evaporation of moisture. If harrowed immediately following the plowing then the soil will be able to hold literally tons of moisture which would otherwise escape. Thus moisture supply for growing crops will be abundant throughout the entire season, even through droughts, meaning in many cases the difference between success and failure.

(2) After considerable quantities of fresh organic matter have been plowed under, the moisture conserved by frequent harrowing will hasten the decay of such organic matter and hasten its change into soil humus. The further effect of harrowing will be to improve the ventilation of the soil, thus contributing also to the conditions favorable to a quick decomposition of the vegetable growth and its final breaking down into desirable humus.

(3) Provide a well settled, firmed, or compacted seed bed. This is done first by permitting time to elapse between plowing and seeding; second, by constantly working the field with disk, harrow and roller.

(4) Provide a seed-bed that will be free of weeds.

(5) By harrowing the field quickly after plowing and working it continually secure a moist condition of soil, hastening germination and favoring young growing crops during possible periods of drought.

(6) If following a clean culture crop a well settled seed-bed and well cultivated soil is provided already; therefore do not plow such a field. Disking and harrowing will in this case usually properly prepare for a vetch seeding.

(7) Likewise the preparation of the soil, when vetch or other legumes are sowed between the rows of hoe crops after the last cultivation, is in every way favorable and usually preferable to that ordinarily provided for vetch seeding.

(8) In laying out the field plan for a check plot to be seeded with uninoculated seed for comparison with the main field which is inoculated with "NITRAGIN."

SEED

(1) The best seed is the cheapest seed. Buy reliable seed.

(2) Several weeks in advance of seeding procure samples of seed from the seed house of which you expect to purchase seed and have samples tested at the Experiment Station of your own state or by the United States Department of Agriculture at Washington, D. C., or—

(3) Make a home-germinating test whenever possible.

(4) Estimate impurities in the sample.

(5) Determine percentage of germination.

(6) Do not buy old seed.

(7) Purchase "NITRAGIN" and inoculate seed before sowing on fields where vetch has never been grown or on fields that have not raised the crop for some years, or on fields that have failed to give profitable yields. Remember first to prepare the soil and treat it in the right way to make a suitable home for the germs freshly stocked in the soil by means of the "NITRAGIN" culture applied to and sown with the seed.

(8) Order "NITRAGIN" for the variety or varieties of vetch which you intend to sow and for the acreage to be sown.

(9) Since "NITRAGIN" is a laboratory product and is always supplied fresh, your order should be booked well in advance of seeding time.

(10) Remember "NITRAGIN" germs, as now prepared, are guaranteed to be virulent and effective for six months from date of shipment, thorough tests having proved conclusively that the germs are effective in producing inoculation several months after they are put in the "NITRAGIN" cans.

(11) Purchasers of "NITRAGIN" will find a book containing full directions for care and use of the inoculation material "NITRAGIN" with each and every shipment of same.

(12) In determining what variety of vetch seed to buy consider well what kind will be most profitable as a crop on your land. Carefully read the requirements peculiar to each variety as discussed in this book before purchasing seed.

(13) Seed of hairy vetch is often adulterated, especially with that of common vetch and of wild vetches, and weed seeds are frequently present. Careful examination with the aid of the descriptions in this booklet will help enable anyone to determine whether the seed is pure.

SEEDING

(1) The time of seeding and amount of seed depend on the variety used, the geographical situation, and what use is to be made of the crop.

(2) Vetch may be sown alone or with one of the small grains as a supporting crop, and is frequently sown with crimson clover.

(3) The depth at which seed is planted depends on the nature of the soil. It is planted deeper in sandy or loose, light soils or soils where depth is required to insure sufficient moisture for germination.

(4) In loose, light soils it is advisable to roll the ground well both before and after seeding to secure a seed-bed sufficiently firm to insure a close contact of soil with seed. Rolling also has the further desirable result of increasing the water-holding capacity of such soils. Following the last operation of rolling the ground it is well to lightly harrow the surface to lessen the action of the wind and loss of moisture through evaporation.

(5) To rid fields of troublesome weeds, clip high so as to cut off the heads of the weeds. Rake these up if extremely heavy; if not, leave on the ground as a mulch.

10 SOIL DON'TS.

(1) Don't hesitate to grow vetch because it is comparatively a new crop. Give it a trial, either as a forage or fertilizing crop.

(2) Don't think that crop rotation alone will build up your soil. It needs the helpful bountiful assistance of a hardy, vigorous legume like hairy vetch.

(3) Don't forget that farm values are based on soil fertility. When you put more fertility in your soil you are putting more money in your till. Hairy vetch fills the bill in a-bil-i-ty and it fills the till in fer-til-i-ty.

(4) Don't forget that the cash value of your farm depends on how, when, and what you feed it.

(5) Don't forget that the best farmer is he who most economically puts back into the soil each year more fertility than his growing crops remove.

(6) Don't forget to forget how the pioneer farmer farmed. Think only of the way your soil must be fed and farmed today.

(7) Don't forget that it is money thrown away to use commercial fertilizer on soils lacking in organic matter.

(8) Don't forget that it takes plant food to grow weeds; kill the weeds.

(9) Don't forget that soil-building is the most vital problem of the century.

(10) Don't forget that hairy vetch makes the best soil-building material.

10 VETCH SEED DON'TS.

(1) Don't try to save money by purchasing cheap seed.

(2) Don't trust to luck for getting the best seed. Buy from a firm such as Galloway Brothers-Bowman Co., Waterloo, Iowa, U. S. A., known to handle only pure unadulterated seed.

(3) Don't put any stock in seed offered on the market as "inoculated" seed. Inoculation by such a method cannot be fairly claimed as reliable.

(4) Don't take chances by sowing seed on water-soaked land, on land that is poorly drained, or on the snow in spring.

(5) Don't throw money away by seeding vetch on newly plowed land, no matter how carefully prepared; give it time to settle.

(6) Don't plant vetch on soils new to the crop without first inoculating the seed with fresh "NITRAGIN" culture prepared for the variety and for the acreage which you intend to sow.

(7) Don't plant vetch seed on soils that have not raised the crop for several seasons without using "NITRAGIN" to supply a fresh stock of germs.

(8) Don't plant vetch on very sour land. If the field is found to be very acid, see that it is well limed a few weeks previous to the planting.

(9) When using "NITRAGIN"-treated seed don't allow the seed to be exposed to the sun's rays after they are treated, for intense light kills the germs; therefore, sow "NITRAGIN"-treated seed and preferably with a drill. If broadcasted or sown with a seeder this should be done early in the morning or late in the evening, or else on a cloudy day, in a mist, or in a drizzling rain. The harrowing following the seeding should be done before the sun comes out.

(10) Don't spread disease or the seeds of noxious weeds by attempting to inoculate your soil by means of soil transferred from old fields where fungus diseases are sure to abound.

10 CROP DON'TS.

(1) Don't forget that when vetch is spring-sown for seed it is best to pasture the crop the first season.

(2) Don't fail to exercise care in pasturing vetch crops. Prevent too close pasturing in the early spring and likewise avoid this in the late fall, else the crop may not have the protection it needs in the winter.

(3) Don't try to cut vetch hay during rainy seasons when it cannot be properly cured. Rather take the risk of having it over-ripe. If provided with suitable equipment another plan is to cut the crop and use it green for ensilage.

(4) Don't think that the sun's rays are necessary to cure hay. The circulation of air is the curing agent. More damage than benefit is caused by the sun, since the leaves are usually burned, preventing evaporation of moisture and causing them to shatter, whereas if they are shade-cured a large percentage of them can be saved, thus making a hay of the highest quality. Shade-curing is facilitated by using hay caps.

(5) Don't overlook the high protein content of vetch or fail to make the right use of it in the ration, whether fed as pasture, ensilage or as hay.

(6) Don't forget that, pound for pound, vetch hay as a ration for live stock is very nearly equal in nutrient value to wheat bran. It is palatable and digestible and live stock eat it greedily.

(7) Don't forget that inoculated vetch contains about 50 pounds of nitrogen per ton while the average farm manure contains 10 pounds of nitrogen per ton.

(8) Don't forget that plowing under $2\frac{1}{2}$ tons of vetch provides as much nitrogen as would be added to the soil by applying $12\frac{1}{2}$ tons of barn manure.

(9) Don't forget that organic matter is the life of the soil; that the productive power of your land is proportionate to the amount of organic matter in it.

(10) Don't forget that when looking for building material with which to increase the fertility of your soil you should not only get the right lumber but you should employ the right carpenter. There is only one thorough, capable carpenter and that is Nature, herself. It was she who built up all rich, virgin soils, and she is the only restorer of worn-out lands. She, alone, can transform infertile sandy land into rich productive soil. Give her good building material—and there is no better than inoculated hairy vetch—and she will provide all the tools and do the greater part of all the work. She will build up and strengthen your thin hungry soil and fill it with the kind of humus that makes big, bumper crops.

HOW TO USE

"NITRAGIN" is sold by the acre—not by weight—and is put up in round tin cans—in two sizes: one-acre and five-acre. The one-acre can weighs about one pound and contains enough "NITRAGIN" to inoculate the seed for one acre of any legume crop. The five-acre can weighs about five pounds and contains enough "NITRAGIN" for five acres. Every can is fully guaranteed for six months from date on can.

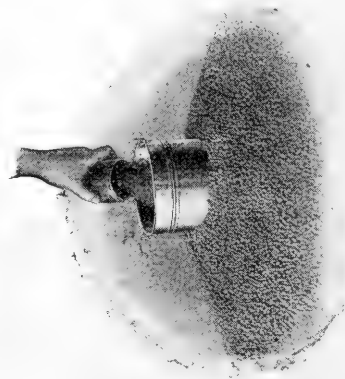


"NITRAGIN"

CAUTION—On each can of "NITRAGIN" there is stamped a date. Always look for this, as our guarantee runs for six months from the date thus stamped on each can.

To Open Package—Set the can down on its top—bottom upwards. The tin here is very soft. Insert a pointed knife blade through the tin near the edge and cut out the bottom by running a knife around it. To avoid losing any of the contents, spread a sheet of clean paper on a table and set the can on the paper.

The following illustrations show the manner of mixing a can of "NITRAGIN" with water, sugar and seeds.



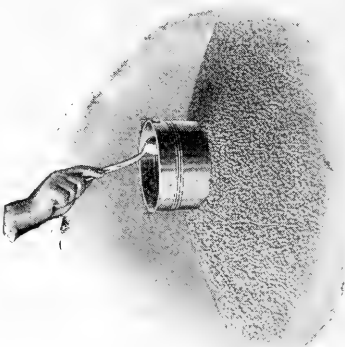
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Place the seeds to be treated in a compact pile on the floor. Set a dish containing water on top of pile and pour into it entire contents of package. Use one pint of water to every acre of "NITRAGIN" used.



2

Add two tablespoonfuls of sugar to the mixture of "NITRAGIN" and water, for each acre of "NITRAGIN" used.



3

Stir thoroughly for two or three minutes until well mixed.



4

Pour entire mixture over the seeds
—leave none in the dish.



5

Mix thoroughly with the hands until
every seed kernel is moistened.



6

When larger quantities of seeds are
to be treated, use a garden rake, in-
stead of the hands for mixing "NI-
TRAGIN" with seeds.

When the seeds are all moistened with the mixture, spread them out on the clean floor to dry. Keep away from the
sunshine. When dry enough to handle, plant the seeds in the usual way.

KINDS OF "NITRAGIN"

Remember that different legume crops require different varieties or "Strains" of "NITRAGIN" field germs. Each
can be labeled with the name of the legume crop for which the can contains the proper "Strain" of bacteria. **Do not at-
tempt to use the bacteria labeled for one crop on the seed of another crop.**

"NITRAGIN" is prepared for each of the following legume crops:

Alfalfa	Florida Clover	Sainfoin	Chick Peas
Red Clover	Yellow Clover	Fenugreek	Sweet Peas
Mammoth Clover	Yellow Suckling Clover	Field Beans (all kinds)	Garden Beans (all kinds)
Alsike Clover	Seaside Clover	Hairy Vetch	Black Bitter Vetch
Crimson Clover	White Clover	Horse Beans	Woolly-Podded Vetch
Sweet Clover	White Dutch Clover	Lima Beans	Scarlet Vetch
Japan Clover	Burr Clover	Navy Beans	Purple Vetch
Berseem Clover	Serradella	Garden Peas (all kinds)	Peanuts
		Velvet Beans	
		Cowpeas	
		Soy Beans	

NOTE—In ordering "NITRAGIN" be very particular to specify the kind of legume you wish to plant. **THIS IS VERY
IMPORTANT!**

Price of "NITRAGIN"—\$2.00 per acre. (If to be sent by
parcel post add proper postage, counting one pound for
each acre ordered.)

GALLOWAY BROTHERS-BOWMAN CO.,
WATERLOO, IOWA, U. S. A.
Sole Distributor for United States and Canada.

Pure Unadulterated Seeds

Good, Pure Seeds Make Good, Thrifty Crops--
Poor Seeds Make Poor, Sickly Crops--
Dead, Worthless Seeds Make No Crops at all

The Galloway Brothers-Bowman Company are Importers, Breeders and Growers of Pure Unadulterated Farm, Garden and Flower Seeds of all kinds and varieties.

We handle only the very best Seeds—Seeds that are true to name and of high germination.

Legume Seeds, Especially, Should Be Pure

Alfalfa, the clovers and other legume crops form the backbone of modern agriculture.

Inoculated legume seeds are the Keystone to successful, Profitable farming.

Poor, adulterated, weed-infested legume seeds, or seeds of any kind are worse than no seeds at all.

Pure Legume Seeds Our Specialty

We specialize on legume seeds. See list of legumes on page 73.

Send for Our Big Seed Catalog

Don't for goodness sake be careless about buying seeds for your farm or garden. Buy from those who attach a greater interest to modern, profitable farming than they do to the "Commercial" side of the seed business.

Galloway Bros.-Bowman Co.

WATERLOO, IOWA,

U. S. A.

P. S.—It is best, always, to place your orders for Seeds and for "NITRAGIN" as far in advance of the seeding season as possible. There always have been, and probably always will be, men who put off buying their seeds until the last minute. Some of these slow ones are sure to be disappointed. **Don't delay.** Get our seed catalog and make out your order **Now.** Send it to us so we can reserve what you need. You can pay for the seeds later—but order **NOW.**

Be Sure That Your Seeds are Pure, Unadulterated and True to Name. Order From Us—and Order Now

What Others Say About "Nitragin"

Nothing is so convincing of the merits of any product as the unbiased testimony of those who have used the product in question. On this and the following pages are published some of the many interesting letters and reports from users of "NITRAGIN," as well as reports from Agricultural Experiment Stations. These show how this imported soil inoculator has benefited others—and how it will enable you to get bigger and better crops, at the same time making your land more fertile. In the files of our office there are many more letters that are as interesting and convincing. The letters and reports that follow are necessarily shortened in order to save space, but the facts are not changed in the least. We invite you to write to any of these parties for their opinion of "NITRAGIN". The original letters are on file in our office where you may inspect them any time you wish.

REPORTS FROM AGRICULTURAL EXPERIMENT STATIONS.

Delaware Agricultural Experiment Station.

"Replying to your letter of recent date in regard to our success with your cultures for treating certain leguminous plants will say that as far as we have tried them, the cultures are successful. The serradella was not sown until August as we find, for most legumes, that fall seeding is much better. The soy bean and vetch were, well supplied with nodules and I feel sure that the inoculating material is satisfactory.

Yours very truly,

A. E. GRANTHAM,
Agronomist.

Delaware College, Newark, Del.
Nov. 26, 1912."

Alabama Agricultural Experiment Station Bulletin No. 87.

"Inoculation with 'NITRAGIN' greatly increased the yields of hairy vetch, Canada peas and crimson clover, as compared with untreated plants. The increase in weight, after drying the plants, was as follows: Hairy vetch, increased 89 per cent; Canada field peas, increased 138 per cent; crimson clover (young plants), increased 146 per cent."

New Hampshire College of Agriculture, Durham, N. H., November, 1911.

"Results of the 'NITRAGIN' culture you sent us last spring—alfalfa—good catch secured—cowpeas and soy beans—inoculated showed gains over those not inoculated.—(Signed) F. W. TAYLOR, Director."

New Jersey Agricultural Experiment Station Bulletin No. 226.

"The weights of dry matter in the inoculated crops (alfalfa) amply demonstrated the culture of 'NITRAGIN' employed for inoculation was very satisfactory for the purpose for which it was intended." (Alfalfa yield increase due to "NITRAGIN" was 500 per cent. Beans increased 75 per cent. Lima beans and cowpeas more than doubled.)

Agricultural Experiment Station of the University of Kentucky, Oct. 1, 1909.

"Results with the sample of 'NITRAGIN' sent us last spring indicate that there was an increase in the number of nodules, due to inoculation, and in soil deficient in nitrogen this would mean an increase in the nitrogen left in the soil by the plants.—(Signed) H. GARMAN, Entomologist and Botanist."

Three Recent Reports from Agricultural Colleges in the South.

"Last winter I put 'NITRAGIN' on some alfalfa as a top dressing, after the alfalfa had come up. In spite of the fact that the winter was unusually severe the alfalfa was very much benefited by this top dressing. The alfalfa just beyond where I made application received no inoculation whatever, and at present is practically dead.

Yours truly,

F. G. TARBOX, Jr.,
Asst. in Agriculture.

Clemson College, S. C.
J. N. Harper, Director.
July 23, 1912."

"Your letter of the 8th inst. received. We inoculated the velvet beans and the cowpeas on May 16th, and planted the following day. Nodule formation is taking place nicely and causing a far better growth than those that were not thus treated.

Sincerely yours,

F. H. CARDOZO, Director.
Agricultural College,
Tallahassee, Fla., July 15, 1912."

BY JACOB G. LIPMAN,

Director of the New Jersey Agricultural College Experiment Station.

In his latest work published in 1911, entitled "Bacteria in Relation to Country Life," page 229, Mr. Lipman says: "A gradual improvement has been made in the character of artificial cultures and has led, within the last two or three years, to very gratifying returns from their use in Germany. The so-called new 'NITRAGIN' is restoring the confidence in artificial culture. Extensive experiments with such cultures, conducted throughout Germany, and especially Bavaria have yielded very promising results within the last three years. A positive increase from inoculation has been obtained, not only on soils that have never borne legumes, but also on cultivated soils in which these crops (legumes) have been raised more or less extensively. The latter fact is of considerable significance because it shows that the introduction of artificial culture into the soil may add to it not only a large number of organisms, but also the kind that are more vigorous and more efficient than those already present there."

A Few Letters From "Nitragin" Users

Lima Beans—Red and Crimson Clover.

I used "NITRAGIN" on an acre of Lima beans and it gave results equal to what 600 or 800 lbs. of bone or 300 lbs. of nitrate of soda would have done and is first-class for beans. I intend to use it next year. I also used "NITRAGIN" on clover with splendid results and think it first-class for legume crops.

Yours very truly,

JOHN F. LEED.

Waterford, N. J., Dec. 12, 1912.

Crimson Clover.

I used "NITRAGIN" according to directions with little confidence, but after taking particular notice of the clover after coming up, knowing that it was planted on land that was naturally a poor clover soil and in a very poor state of fertility, I find that my clover is far superior to any clover crop in my section, even those that planted on old clover lots. The results are astonishing to all who have seen my clover.

Yours very truly,

W. T. STANCELL.

Margarettsville, N. C., Dec. 13, 1912.

Peas—Alfalfa—Hairy Vetch.

I used "NITRAGIN" in April on peas (peas and oats), of which I had a large crop.

The alfalfa and hairy vetch seeded in August made a splendid growth. Before frost alfalfa was 18 inches high, vetches are thick and green. I am highly pleased with success I have.

Yours very truly,

LOUIS GIROUARD.

Manville, R. I., Dec. 13, 1912.

Alfalfa.

I desire to state that the results derived from the use of your alfalfa culture are perfectly satisfactory. I had no difficulty whatever in obtaining a good stand and the plants have a particularly thrifty appearance.

Heretofore I have been rather skeptical as to the use of any commercial culture, but I am satisfied that yours is particularly effective. Shall want more in August.

Yours very truly,

GUS A. BUNTE.

Quincy, Ill., Dec. 14, 1912.

Canada Peas.

I planted the peas with oats and had very good luck. A neighbor planted some just across the road from mine. He put fertilizer on his while I had nothing on mine but "NITRAGIN" and mine was far better than his. His peas did not have any nodules on the roots and mine had bunches of it. I am going to get more "NITRAGIN" this year. I think it is a good thing and I am going to do the best I can to get my neighbors to use it.

Yours very truly,

HOWARD F. WHITE.

North Leverett, Mass., Dec. 29, 1912.

Winter Vetch—Canada Peas—Alfalfa.

I used "NITRAGIN" on alfalfa sown August 1st. Got a fine stand with lots of nodules on the roots. My Canada peas treated with "NITRAGIN" did well with a number of nodules on the roots. The winter vetch were loaded with nodules on the roots where treated, while the test patch not treated had none. In short I think "NITRAGIN" a success.

Wishing you the compliments of the season, I am,

Yours very truly,

J. V. McCULLEY.

Rayland, O., R. F. D., Dec. 31, 1912.

Alfalfa—Alsike Clover—Garden Peas and Beans.

Regarding the results I got from the use of "NITRAGIN", will say that it worked wonderfully on the alfalfa, alsike clover, garden beans and garden peas. I harvested a crop of 87 bu. of green peas which sold at \$2.00 and \$2.50 per bu. at the Grand Rapids market. It certainly pays market gardeners to use "NITRAGIN."

Yours very truly,

JOHN VAN SCHIE.

Grand Rapids, Mich., Dec. 11, 1912.

Cowpeas.

At the request of your Mr. Davis, I am writing to tell you the success I have this season with the "NITRAGIN" I used to inoculate my cowpeas. On May 15th I seeded to cowpeas, planting some in a fair clay soil which had been limed and manured, sowing 100 lbs. of seed to the acre.

The cowpeas inoculated with "NITRAGIN" are much ranker and sturdier in growth and have a richer, darker green color than the uninoculated and the cowpea itself is much larger. Upon digging up several plants, with a spade, I found that upon the roots of the inoculated plants there were nodule formations in great abundance; where as on the roots of the untreated plants there were few nodules, if any. I estimate that the yield of my inoculated cowpeas to be at least 200 per cent greater than that of the uninoculated. The "NITRAGIN" treated and untreated peas were sown at the same time on soil prepared under similar conditions. That you may note the remarkable contrast between the treated and untreated peas, I am sending you a few plants each of the respective crops. I called in several of the neighbors and surrounding farmers to see the great contrast in color and growth and all were greatly surprised to see the difference and stated that they were going to try "NITRAGIN".

D. M. WALKER.

Spray, N. C., Sept. 20, 1912.

Garden Peas.

Two years ago, 1909, I purchased from your firm some "NITRAGIN" which I used for peas, and I certainly harvested an unusually large crop. Last year I did not

use "NITRAGIN" and had no crop at all, so I think I better have some this year. Enclosed please find order.

Respectfully yours,

WM. EPLER.

Altoona, Pa., Feb. 18, 1912.

Alfalfa.

We sowed five acres to alfalfa about May 15th, treated seed with "NITRAGIN" and have a good stand. We also sowed five acres adjoining, seed not treated, and the stand is about 60 per cent as good as that where treated with "NITRAGIN."

Yours very truly,

PLAINVIEW STOCK FARM.

Redfield, S. Da., Dec. 10, 1912.

Field Peas—Serradella.

I sent you specimens of peas inoculated and uninoculated which you thought showed a remarkable contrast, and indeed they did.

Regarding serradella, I sowed four acres as a catch crop to plow under. After oats were harvested it came along good and now stands green under the snow. Made a test of $\frac{1}{4}$ acre with serradella. Sowed seed May 10th. About July 8 or 10 I ran mowing machine over it lightly to cut weeds which had sprung up. Serradella at that time was about four or five inches in height, had about one ton of green fodder. In forepart of September I commenced to cut again to feed thirty dairy cows and that $\frac{1}{4}$ acre lasted 14 days to feed 12 cows twice a day.

A neighbor of mine wants ten acres of red clover "NITRAGIN" for spring seedling and I myself want a lot of it.

Yours very truly,

ANDREW M. CHRISTENSEN.

Norwich, N. Y., R. F. D., Dec. 11, 1912.

Alfalfa.

I am well pleased with "NITRAGIN". I sowed some alfalfa two years ago and inoculated the ground with dirt from an old alfalfa field, but that did not suit me very well; there were yellow spots all over the field. But not so with last year's crop. Where I used "NITRAGIN" it was the nicest alfalfa field I ever saw, so I must say I am well pleased with it.

Yours very truly,

CHAS. OHLFEST.

Valparaiso, Ind., Dec. 9, 1912.

Red Clover—Garden Peas and Beans.

The red clover I treated with "NITRAGIN" did fine. They started early and grew right along when we cut the oats, which were very heavy crop. One could hardly see the oat stubble upon the clover and it grew right along until frost, the best piece I have seen by all odds.

The garden peas and beans grew to a high state of perfection in productiveness, size and quality. I took the lead at the Chautauqua market. The neighbors all came with baskets for a mess of green peas and beans and pronounced them simply grand. I pulled up some roots which were a sight to see, completely covered with nodules.

Yours very truly,

ROBERT HEWES.

Mayville, N. Y., R. F. D., Dec. 10, 1912.

Alfalfa.

Alfalfa never has proven a success in this vicinity. I sowed one acre July 20th, 1912, with no nurse crop, using "NITRAGIN" and 1,500 lbs. of lime per acre. The result was thoroughly amazing. When frost came we had a stand of 12 to 15 inches of healthy plants, thick as it could stand. I expect to sow four acres next year.

Yours very truly,

DR. G. E. SYLVESTER.

Black River, N. Y., Dec. 11, 1912.

Peas.

I am very well satisfied with results of "NITRAGIN" which I used for my canning peas last spring. It was easy enough to tell where I used it and where I did not, as I had much better growth and heavier pods where the "NITRAGIN" was applied.

Yours very truly,

W. S. MATTESON.

Waterville, N. Y., Dec. 6, 1912.

Alfalfa.

Your "NITRAGIN" has worked wonders for me. On the 10th of August, 1912, I seeded ten acres to alfalfa, treating seed with "NITRAGIN". This was the first I had ever sowed, in fact the first ever sowed in this section. The piece of land was not cropped, but thoroughly worked all summer. I also used 1,000 lbs. of raw lime rock per acre. I have the finest catch I ever saw and had it not been for a severe freeze early in October it would have blossomed this fall. It has a very healthy color, and after washing roots I find that each one contains a large cluster of nodules. Will order more in the spring.

Yours very truly,

W. E. MASON.

Oriskany Falls, N. Y., Dec. 14, 1912.

Serradella—Peas—Clover—Alfalfa.

Referring to your inquiry of Oct. 24th as to the success of my experiment in sowing serradella, I am glad to report that it was very satisfactory. It was sowed in May on an acre of winter wheat when the wheat was about six inches above the ground. It was harrowed in by a smoothing harrow without injuring the wheat, which was cut green for feed for cows. Very hot, dry weather followed and the serradella was seriously affected by it, but later, with abundant rains, it started up, vigorously and grew until late in September when it was about two feet high and was cut for hay. We thought it would make about a ton and a half per acre, but long abundant rains followed and not sun enough to cure for hay so late in the season. So it was fed to the cows as green forage. It was relished by the cows who yielded abundantly and as well as when fed on peas and oats, which had been their accustomed forage during the summer. We watched them with interest and frequently dug up plants and in every instance found the roots well covered with nodules like bunches of grapes. They must have left a large amount of nitrogen in the soil for the benefit of next year's crop.

I have also found "NITRAGIN" to be successful in growing large crops of peas, clover and alfalfa. The alfalfa, sowed early in August, covers the ground all over and is from one to two feet high at this time and will, I believe, protect the roots during the winter and if so yield heavy crop next season on ten acres or more.

The soil on my farms is a heavy clay loam, no fertilizer other than marl was used with the serradella. I have named one of my Guernsey heifers "Serradella" and hope she will turn out as well as my "NITRAGIN"-growing plants.

Yours very truly,

EDWARD R. ANDREWS.
Elm-Leigh Farm.

Putney, Vt., Oct. 29, 1912.

Alfalfa.

I have a field of alfalfa on which I used your "NITRAGIN", which is a very nice stand of alfalfa. I cut it two times this year. There are a number of farmers in my neighborhood that have been watching my field to see what your "NITRAGIN" would do for it, and now wish to send and order "NITRAGIN" another spring. I will also send for more myself.

Yours very truly,

LEWIS CORNUÉ.

Fabius, N. Y., Dec. 18, 1912.

Soy Beans.

I treated 1½ bu. of soy beans with the two cans of "NITRAGIN" on the day it was received and sowed them on one and a half acres of ground. This was about July 10th. The ground was clover meadow plowed after the hay was cut. I did not sow any without the cultures this time. But two years ago with the result of at least 18 inches growth in favor of the "NITRAGIN"-treated seed, which made an average growth of 2½ feet. The soys did not seed very well and we cut over two tons of hay from the piece about October first. The roots examined showed an abundance of nitrogen nodules. I am expecting better corn on that part of the field on which they grew, next season.

Yours very truly,

W. B. LEE.

Rochester, Ohio, Dec. 11, 1912.

Red Clover.

I tried "NITRAGIN" on clover which was sowed in fall wheat, and although the ground was relatively poor as it had been overworked and not properly nourished, I got as beautiful a stand of clover as I have seen anywhere in this part of the country. I had sowed a small strip of untreated seed for trial and could notice a very marked difference between the treated and untreated clovers.

With best wishes for a prosperous New Year, I am,

Very truly yours,

J. M. CALKINS.

Town Line, N. Y., Erie County, Dec. 20, 1912.

Alfalfa.

I have been using soil inoculation in trying to raise alfalfa and clover for ten or twelve years and will say that it has been rather discouraging.

The "NITRAGIN" that I bought last spring I used as per directions about June 16th and have a very fine stand with plenty of nodules on the roots. I am pleased with the looks of the crop and the outlook is more favorable than ever before.

Yours very truly,

B. R. KNAPP.

Cortland, N. Y., Dec. 25, 1912.

Red Clover—Alfalfa.

I have three acres of "NITRAGIN"-treated red clover and it is a very good stand. No man could be able to make a catch with this clover any better even if he had a machine to do so.

As for my three acres of alfalfa, I could not wish it to be any better. Of course we had a wet summer for it, still there are some farmers that have a very poor catch and some with no catch at all.

Yours very truly,

WALTER SPRANGERS.

Royalton, Wis., Dec. 10, 1912.

Soy Beans—Alfalfa.

I believe "NITRAGIN" is alright. My soy beans came doing fine and were just as full as they could be from the ground to the top. In fact so full I could not cut them with a machine. I had to pull them up root and branch. Had I cut them I would have wasted twice as many as would seed the ground as the stalks were so full the branches lay to the ground. I believe if I had a machine to plant them just right there would have been 35 to 40 bu. per acre and of the best quality. The alfalfa looks fine.

Yours very truly,

T. C. HATCHER.

Westerville, Ohio, Dec. 12, 1912.

Alfalfa.

By using your "NITRAGIN" we have a good stand of alfalfa.

It is the best investment we ever made.

Yours very truly,

GUSTAV JORDAN.

Flanders, N. J., Dec. 16, 1912.

Crimson Clover.

The crimson clover seed I sowed, after inoculating with "NITRAGIN", looks good and I can see the value of it.

Yours very truly,

KARL B. BIESELIN.

Elwood, N. J., Dec. 28, 1912.

Alfalfa.

Last year I sowed two acres of alfalfa on soil well manured, but not inoculated. It made a splendid start, but no nodules formed on the roots. This past season (August) I plowed one-half up and re-seeded; also tried another piece of three acres, using "NITRAGIN" as per instructions. In each case nodules began to form by the time the alfalfa was three inches high. I am convinced that the use of "NITRAGIN" is no "theory," and if conditions in the spring should bear out my present opinion, I should say that a person was very short-sighted who would try to raise

any of the legumes without some form of commercial inoculation.

For the past two years I have read everything available on the subject of alfalfa and find more real information in your alfalfa book than from all other sources. If the clover book is anything like it, I sure would be pleased to have a copy.

Yours very truly,

F. D. WEBSTER.

Supt. Brookside Farm.

Armonk, N. Y., Dec. 12, 1912.

Cowpeas.

The "NITRAGIN" was used by my son on cowpeas in Marion County, Texas. I have asked him to write you, stating results. I know the vines and fruit were much heavier where "NITRAGIN" was used than where it was not.

Yours very truly,

R. O. ELSEA.

Columbia, Ohio, Dec. 7, 1912.

Canada Peas—Red Clover—Alfalfa.

During the year I have used your "NITRAGIN" on the seeds of red clover, Canada peas and alfalfa. Had good catches of clover and peas, they grew finely and I have examined the roots of each and find that they were covered with the much desired nodules.

The alfalfa was sown in the latter part of August. It grew nicely and on Nov. 1 was over one foot high. I have also examined the roots of the alfalfa and find them covered with the nodules, too. Alfalfa has not been grown in our neighborhood.

Yours very truly,

F. J. HANNAH.

New Brighton, Pr., Jan. 4, 1913.

Canada Peas.

Regarding my success with "NITRAGIN" will say that I am at a loss to express my satisfaction. I planted the inoculated Canada peas with oats on new land just slashed and burned over. Some had practically no lime, some had a moderate application and on some the lime lay heavy. The soil was light, sandy loam, high and well drained and rather dry, but we had lots of rain for the West this year. Most of the seed was inoculated—a little was not—I also planted one strip without oats. I cut for hay about 50 days from planting. There was no way to tell how much it made, but the growth ran from about nine inches where the seed was inoculated on unlimed land, to seven feet high where land was moderately limed and seed inoculated, peas grown alone. The average height of treated peas was about five feet for both peas and oats. The average where not treated was about two feet. Am enclosing an average root dried. Will never plant again without "NITRAGIN".

Respectfully yours,

GEO. F. HATCH.

Rathdrum, Idaho, Sept. 23, 1912.

Field Peas.

Yours of the 5th instant acknowledging receipt of two specimens of field peas at hand. Your request of sending you more specimens of both treated and untreated plants, will say that I cut down the field of peas August 2nd and so am unable to send you nice whole plants, but some were left which the mower went over. I will send you some of these. Yes, sir, the contrast is great and the plants I send you this time are simply grand. The whole field is full of bacteria everywhere. Next spring I shall use a larger amount of "NITRAGIN" as I am planning to go over my land with legume plants as fast as possible after seeing the results "NITRAGIN" brought this year.

The peas sowed May 10th yielded a good crop of green fodder July 10th. These plants sent you were dug August 1st.

Yours very truly,

ANDREW M. CHRISTENSEN.

Norwich, N. Y., Aug. 12, 1912.

Canada Peas.

I think you have my report on page 10 of your booklet of testimonials. Will state further, however, that I showed roots inoculated with "NITRAGIN" to the professors assembled at Farmers' Institute, one of whom made a specialty of the business. Another was President McLean, of the Idaho State University. They all agreed that they had never seen such development before. I told them it came from the "NITRAGIN" Co.

Yours very truly,

GEO. F. HATCH.

Rathdrum, Idaho, Dec. 13, 1912.

Cowpeas.

I purchased enough of your "NITRAGIN" to inoculate ten acres of cowpeas. I sowed them only for a fertilizer and will say they made a wonderful growth. I drilled them in the corn on ground that was inclined to be thin, but the peas made a wonderful growth, and am well pleased with the results obtained from same. This same ground will be sown in oats next spring. I shall then note the condition of the soil.

Yours very truly,

F. H. JOHNSON.

New Augusta, Ind., Dec. 13, 1912.

Serradella.

I sowed the serradella as directed. I got a fine stand and the roots show an abundant supply of nodule formations.

I think farmers will soon find out the necessity of using "NITRAGIN".

Yours very truly,

L. D. GALE.

Sherman, N. Y., Dec. 10, 1912.

Alfalfa.

I used your "NITRAGIN" for alfalfa and found it all you claimed it to be.

Yours very truly,

O. M. BISHOP.

Athens, Pa., Dec. 26, 1912.

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Restores and Maintains Soil Fertility

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"NITRAGIN" is shipped to all parts of the United States and Canada at the uniform price of \$2.00 per acre.

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But each legume has its particular strain of bacteria. When ordering specify the legume for which you wish to use "NITRAGIN."

"NITRAGIN" is prepared for each of the following legume crops:

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Red Clover
Mammoth Clover
Alsike Clover
Crimson Clover
Sweet Clover
Japan Clover
Berseem Clover
Florida Clover
Yellow Clover
Yellow Suckling Clover
Seaside Clover
White Clover
White Dutch Clover

Burr Clover
Serradella
Sainfoin
Fenugreek
Yellow Lupins
White Lupins
Blue Lupins
Canada Peas
Field Peas (all kinds)
Garden Peas (all kinds)
Chick Peas
Sweet Peas
Field Beans (all kinds)
Garden Beans (all kinds)

Horse Beans
Lima Beans
Navy Beans
Velvet Beans
Cow Peas
Soy Beans
Common Vetch
Hairy Vetch
Black Bitter Vetch
Woolly Podded Vetch
Scarlet Vetch
Purple Vetch
Peanuts

If you expect to plant any of the above crops you need "NITRAGIN" to insure a "catch," to increase the yield and to enrich your land.

NON-LEGUMINOUS CROPS

Do not order "NITRAGIN" for non-leguminous crops, such as corn, oats, rye, wheat, cotton, potatoes, orchards, small fruit, etc., but,

DO NOT FORGET THAT

These non-leguminous plants are indirectly benefited by "NITRAGIN." All crops must have an abundance of humus and nitrogen in the soil, and the way to make sure of adding these necessities is to plant "NITRAGIN" treated legumes such as clover, serradella, vetch, etc., either in rotation, as cover crops, or for green manuring.

DO NOT TEAR OUT THIS ORDER BLANK

When ordering, copy this form on a piece of paper, simply filling in the kind and quantity of "NITRAGIN" wanted.

ORDER BLANK

Date.....

Galloway Bros.-Bowman Co., Waterloo, Iowa, U. S. A.

Gentlemen:

Enclosed find exchange for \$..... for which please send me
"NITRAGIN" for..... acres of..... (Name of crop)
"NITRAGIN" for..... acres of..... (Name of crop)
"NITRAGIN" for..... acres of..... (Name of crop)
Ship by..... charges collect, to

(Express, Freight)

Name.....

Town..... State..... P. O. Box or R. F. D. No.....

Nearest Express Office.....

On what R. R.

Price of "NITRAGIN" \$2.00 per acre.

If you want the "NITRAGIN" sent by mail, add 10c per acre to prepay postage.



"Feed the soil and the soil will feed you."

—Anon.

"Pure-bred bacteria for specific work are as clearly an economic necessity as pure bred cattle or pure-bred sugar beets." (U. S. Dept. of Agr. Bureau of Plant Industry. Bulletin 296.)

"How long will it take farmers to realize that there is an inexhaustible store of nitrogen over every acre they cultivate, only waiting for the man who will use his brains to get it without hauling it in a sack from a supply company and going in debt for it?" (Editor of the Progressive Farmer—In issue Feb. 2, 1912.)